US Army Corps
of Engineers
Wilmington District

Morehead City Harbor
Morehead City, NC

DRAFT

Integrated Dredged Material Management Plan
And Environmental Impact Statement

Port of Morehead City, NC

October 2013

Morehead City Harbor
Morehead City, NC
DRAFT
Integrated Dredged Material Management Plan (DMMP)
and Environmental Impact Statement

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Executive Summary

The U. S. Army Corps of Engineers (USACE), Wilmington District is responsible for the operation and maintenance of the federally-authorized Morehead City Harbor navigation channel. Engineering Regulation (ER) 1105-2-100 provides that a Dredged Material Management Plan (DMMP) be developed for federal navigation projects if a preliminary assessment does not indicate sufficient capacity to accommodate maintenance dredging for at least the next twenty years. The DMMP is a planning document that ensures that sufficient confined disposal facilities are available for at least the next 20 years and that maintenance dredging activities are performed in an environmentally acceptable manner, use sound engineering techniques, and are economically justified. The final product of this report will be an integrated DMMP and Environmental Impact Statement pursuant to the National Environmental Policy Act (NEPA). The DMMP addresses dredging needs, disposal capabilities, capacities of disposal areas, environmental compliance requirements, and potential for beneficial use of dredged material and indicators of continued economic justification. This DMMP will ensure sufficient disposal capacity for the 20-year period beginning in 2015 and extending through 2034.

The study area for the Morehead City Harbor DMMP includes the Morehead City Harbor navigation channels, the adjacent mainland area, the beaches of Bogue Banks and Shackleford Banks, the nearshore Atlantic Ocean off of Bogue Banks and Shackleford Banks, the U. S. Environmental Protection Agency (USEPA) designated Morehead City Ocean Dredged Material Disposal Site (ODMDS), and the existing disposal sites of Brandt Island, Marsh Island and Radio Island.

The integrated DMMP and Environmental Impact Statement (DMMP/EIS) evaluates the return of sand lost from Shackleford Banks due to maintenance of the navigation channel, to the beaches of Shackleford Banks, which is part of the Cape Lookout National Seashore (CALO). The DMMP/EIS will be used by both Wilmington District and National Park Service (NPS) to evaluate the decision to place sand on Shackleford Banks. The NPS and the U.S. Army Corps of Engineers, Wilmington District (USACE) have formally agreed to be Federal cooperating agencies on the Morehead City Harbor DMMP/EIS. If the NPS were not included in the DMMP, a separate study, including a NEPA document, would have to be completed prior to placement of compatible sediment dredged from the navigation channel, even in the event of continued or more severe erosion along Shackleford Banks. Inclusion of the Shackleford Banks alternative in the DMMP was therefore deemed prudent and consistent with scientific understanding of coastal processes and impacts.

The current Federal authorization for the Morehead City Harbor project consists of both deep draft and shallow draft channels. The deep draft portion of the project provides navigation channels from the deep water of the Atlantic Ocean to the North Carolina State Ports Authority (NCSPA) facilities. The shallow draft portion of the project provides for navigation channels from the waterfront docks at downtown Morehead City to the deep draft portion of the project. Dredging methods and disposal/placement options depend on the channel location and the *in situ* material characteristics. Based on these sediment characteristics and potential disposal locations, the deep draft channels or ranges are grouped into three sections; the Inner Harbor, the Outer Harbor, the Outer Entrance Channel.

Inner Harbor maintenance dredging has historically been accomplished by hydraulic pipeline dredge every 2 to 3 years, with placement in either the disposal area at Brandt Island or on the beaches of Bogue Banks. Brandt Island has been used for disposal since 1955. However, from 1978 through 2005 the majority of Inner Harbor dredged material was temporarily disposed of into Brandt Island and later pumped onto the adjacent beaches of Fort Macon State Park and Atlantic Beach. These beach disposals (Brandt Island Pumpouts) were designed to compensate for any potential shoreline impacts associated with changes in sediment transport attributable to the Federal navigation project (USACE 1976 General Design Memorandum, and USACE 2001 Section 111 Report). Both the Design Memorandum and Section 111 report prepared for this project specifically recognized that beach impacts from the navigation project were offset by the Brandt Island pumpouts.

The most recent Brandt Island pumpout (2005) was problematic in that it included disposal of an unacceptable amount of fine-grained material onto the beach. This disposal of fine-grained material on the beach, along with recent USACE geotechnical investigations, indicates that Brandt Island and portions of the Inner Harbor contain material unfit for beach disposal. Since 2005, only fine-grained dredged material has been disposed of in Brandt Island. Coarse-grained material has been disposed of on the beaches of Fort Macon State Park and Atlantic Beach, within the existing nearshore placement area west of Beaufort Inlet (Nearshore West), in the ODMDS, or on the shoreline of Pine Knoll Shores as part of a beneficial use of dredged material project (Section 933). Due to the presence of fine-grained material in Brandt Island and the cost that would be incurred to attempt to separate the fine-grained material from the remaining coarse-grained material, it is no longer economically feasible to do the Brandt Island pumpouts; therefore, there are no plans for future pumpouts from Brandt Island to the beach.

The Outer Harbor and Outer Entrance Channel maintenance dredging have historically been accomplished by hopper or pipeline dredge on an annual basis. Dredged material from the Outer Harbor has historically been disposed of in Brandt Island along with Inner Harbor material, but more recently has been placed in the approved nearshore placement area west of Beaufort Inlet or on area beaches. The Outer Entrance Channel material, which is fine-grained material, is typically disposed of in the ODMDS within the southwest corner, the area designated for fine-grained material. Accordingly, the northern half of the Morehead City ODMDS is designated for dredged material that is coarse-grained, making it an accessible source of sand for future beach replenishments.

The Morehead City shallow-draft portion of the Harbor project has not been dredged in over 15 years. Although these ranges were considered during the development of the DMMP, they are dredged so infrequently and contain such small quantities of material that they would not affect the base plan and therefore were not included in the detailed analyses conducted for all other portions of the Harbor.

The 2003 through 2008 sediment sampling efforts identified that the Inner Harbor material consists of fine-grained material that is less than 90 percent sand. As a general rule, disposal of dredged material on beaches is limited to that material which is greater than or equal to 90 percent sand. Therefore, Inner Harbor material is not suitable for disposal onto adjacent shorelines. Sampling also showed that the majority of the shoaled material located in the Outer Harbor consists of coarse-grained material that is suitable for beach or nearshore placement (ebb tide delta), with the exception of material in the Outer Entrance Channel from station 110+00 seaward. This new sediment data, as well as the inability to offset potential project impacts through Brandt Island pumpouts, led to the revised management strategy for the Morehead City Harbor project, termed the Interim Operations Plan (IOP). The Environmental Assessment and Finding of No Significant Impact (EA/FONSI) for the IOP were completed in July 2009 and addressed modifications to the existing Morehead City Harbor dredged material disposal practices for an interim period while the Morehead City Harbor DMMP is being developed. The IOP (current base plan) is structured with the expectation that Morehead City Harbor maintenance dredging occurs on a three-year dredging cycle. The IOP was developed using past dredging quantities, recent geotechnical data, and current channel and disposal area conditions.

The first step of the DMMP process was the preparation of the Preliminary Assessment (PA), which was completed by the USACE, Wilmington District in 1997 (USACE, 1997). The PA concluded that there were no significant problems to the continued maintenance of the Morehead City Harbor project, therefore, a DMMP was not recommended. Since 1997, changes have occurred regarding the management of dredged material from Morehead City Harbor. In the past, capacity in the Brandt Island confined disposal site was periodically restored when the material from Brandt Island was pumped to the beach. Because pumpouts are no longer a feasible option, since 2005 (the last pumpout), only fine-grained material has been disposed of in Brandt Island. To address these changes and the implications for future management of the Harbor, development of a formal dredged material management plan is now warranted.

The initial phase of the DMMP began with the identification of dredged material management problems and opportunities, the procedure used to identify measures, the methodology used to select alternatives for further analysis, work tasks and the costs and schedule to perform those tasks. Resource agency and public involvement began in 2009 when a public meeting was held to brief attendees on the Morehead City Harbor DMMP project and process, to solicit comments and input and to invite attendees to participate on the Project Delivery Team (PDT). Attendees included representatives from state and federal resource agencies, interest groups, and stakeholders. Several attendees expressed an interest in participating on the PDT and have actively participated in the development of the DMMP.

This DMMP for the Morehead City Harbor project has been developed using a consistent and logical procedure by which dredged material management measures have been identified, evaluated, screened, and recommended so that dredged material disposal operations are conducted in a timely, environmentally sensitive, and cost-effective manner. Following identification of problems and opportunities, the PDT identified 21 potential DMMP measures for the Morehead City Harbor DMMP which resulted in over 100 dredging and disposal options to be analyzed for the base plan. Analysis and screening of the measures during the plan formulation process resulted in the elimination of several of the DMMP measures. As shown in the table below, those measures that remain viable were combined to form the recommended base plan.

DMMP Cycle	**Harbor Section**	**Navigation Range Dredged**	**Dredge* Plant**	**Proposed Disposal or Placement Location**	**Quantity Likely to be Dredged (cy)**	**Estimated Unit Cost**	**Estimated Cost (per dredging event) ** **
Years 1, 4, 7, 10…	Outer	S. Range B, Cutoff, N. Range A to Sta. 110+00	30-inch pipeline	Fort Macon State Park/Atlantic Beach & Shackleford Banks	1,200,000	$7.82	~$16,791,300
Years 2, 5,8,11…	Outer	S. Range C-N. Range B	hopper	Nearshore West & East	346,000	$4.25	~$6,457,900
	Outer	S. Range B, Cutoff, N. Range A to Sta. 117+00	hopper	Nearshore West & East	650,000	$4.10	
Years 3,6,9,12…	Inner	Northwest Leg, West Leg 1 & East Leg	18-inch pipeline	Brandt Island or ODMDS (Bucket & Barge)	362,000	$4.35	~$10,175,600***
	Inner	West Leg 2 & N. Range C	18-inch pipeline	Brandt Island or ODMDS (Bucket & Barge)	152,000	$4.30	
	Outer	S. Range B, Cutoff, N. Range A to Sta. 117+00	hopper	Nearshore West & East	810,000	$4.10	
	Outer Entrance Channel	S. Range A, Sta. 117+00 out	hopper	ODMDS	344,000	$3.50	

* Specific dredge plants are included for cost estimating purposes only. Actual dredge plant used may vary based on several factors, including but not limited to volume/location of shoaling and dredge plant availability.
** Costs include monitoring, mob/demob, planning, engineering and design, supervisory and administrative costs and 20% contingency
*** When Inner Harbor material is disposed of in the ODMDS (once Brandt Island reaches capacity), costs increase to $12,083,500 per dredging event.

Inner Harbor, fine-grained material would be disposed of in Brandt Island until it reaches capacity in 2028 at which time it would be disposed of in the ODMDS. An essential component of the proposed base plan is beneficial use of dredged material by disposal on the adjacent beaches at regular intervals to ameliorate the possible losses of material caused by dredging. The 2001 Section 111 Report performed to examine the erosive effects of the project concluded that beach disposal on the Fort Macon State Park and Atlantic Beach shorelines was "an integral part of the operation and maintenance of the project," and that the disposal of approximately 5 million cubic yards (cy) of material between 1978 and 2001 "provided more than adequate compensation or mitigation for this possible impact." Shackleford Banks, a part of the Cape Lookout National Seashore, is managed by the National Park Service (NPS) and in the past, the NPS did not want sand from the channel disposed of on Shackleford Banks. As a result of new information regarding navigation channel impacts on Shackleford Banks, in 2010, the NPS requested that sand disposal on Shackleford Banks be considered in the DMMP. Therefore, the base plan recommends disposal of beach quality dredged material on Fort Macon State Park, Atlantic Beach and Shackleford Banks. However, the National Park Service has the option to decline disposal of sand on Shackleford Banks during the life of the DMMP.

Another very important component of the DMMP is the placement of dredged material in the nearshore with the expected benefit of reducing erosion of the ebb tide delta, also referred to as ebb tide delta deflation. For this reason, in years 2 and 3 of the 3-year maintenance cycle, the base plan recommends placement of coarse-grained material (greater than or equal to 80% sand) in Nearshore Placement Areas on both sides of Beaufort Inlet.

The placement of dredged material on the ebb tide delta, which is part of the littoral system, is expected to contribute to the stability of the ebb tide delta thus positively affecting the littoral system and the associated features. Disposal of material directly on the beaches would contribute to improvement of beach stability for beaches of Bogue Banks and Shackleford Banks. However, anytime dredged material is not placed in the ebb tide delta, it may adversely affect the deflating ebb tide delta. An understanding of coastal inlet processes suggests that continued erosion of the ebb tide delta complex is likely to eventually impact the adjacent beaches. The locations, severity and timing of the impact are unknown at this time. It is likely that any impact to the shoreline along Bogue Banks up to this point has been mitigated by previous disposal of federal navigation maintenance material along the eastern end of the island as found by the Section 111 report; however, continued deflation of the ebb tide delta may eventually overtake those efforts. Every practical and sound effort, including reasonable use of light-loaded vessels, will be made to retain littoral material dredged from the navigation channels within the inlet complex to minimize this ebb tide delta deflation. A comprehensive physical monitoring program, as outlined in the Morehead City Harbor Monitoring Plan, will provide data to potentially modify and assess ongoing operations and its impacts.

The proposed Morehead City Harbor DMMP is not expected to result in any significant adverse environmental effects. Significant resources (including terrestrial and marine biota, cultural resources, threatened and endangered species, air and water quality, socio-economics, esthetics, and recreation) will not be adversely impacted by implementation of the proposed DMMP. Localized, short-term, and reversible adverse impacts to intertidal macrofauna (beach infauna) may occur. However, beach disposal areas on both Bogue and Shackleford Banks would recover quickly since only beach compatible material (greater than or equal to 90% sand) would be disposed of on these beaches. Supportive data for these conclusions are found in Section 5.5 entitled Marine and Estuarine Resources and in Appendix J, NMFS and USFWS Biological Assessment.

The three year dredging cycle proposed for the DMMP assumes that funding will be available to dredge and monitor as planned, appropriate dredge equipment will be available, and that unexpected shoaling would not occur. The three year rotational cycle is the base plan, but must remain flexible and adjustable to meet the navigation needs of the Morehead City Harbor Navigation project, therefore, from time to time, the cycle may be adjusted, resulting in fewer dredging events and dredged material quantities that differ from those described in this DMMP. Nothing in this document should be read to suggest that material will be dredged for the purpose of disposal on the beaches or in the nearshore, or for any purpose other than addressing navigability priorities.

In summary, approximately 1 million cubic yards of dredged material are removed from the Morehead City Harbor annually. Current maintenance disposal practices, without modification, result in the need for “new” or expanded disposal sites or modified disposal options, including beneficial uses, by 2028. The proposed DMMP (base plan) provides virtually unlimited disposal capacity for the Morehead City Harbor navigation project by recommending the following: continued use of Brandt Island without expansion, disposal of coarse-grained material on the beaches of Fort Macon State Park, Atlantic Beach, and Shackleford Banks, expansion of the Nearshore West placement area, a new Nearshore East placement area and continued use of the USEPA designated ODMDS. Implementation of the DMMP is estimated to cost approximately $11,900,000 annually. The general navigation features (maintenance dredging) of the Project are 100% federally funded. The only costs incurred by the State of North Carolina, the non-federal partner, are approximately $50,000 annually for maintenance of the spillway boxes at Brandt Island. In conclusion, Brandt Island, the beaches of Fort Macon State Park, Atlantic Beach, and Shackleford Banks, the existing and proposed nearshore placement areas and the EPA designated ODMDS, provide adequate disposal capacity for maintenance of the Morehead City Harbor navigation project to its fully authorized dimensions for at least the next 20 years. The proposed base plan will provide more than adequate disposal capacity to maintain the Morehead City Harbor navigation project to the fully authorized dimensions for at least the next 20 years.

ACRONYMS

AAC	average annual cost
AFB	Alternative Formulation Briefing
AFT	Aviation Fuel Terminals, Inc.
AIWW	Atlantic Intracoastal Waterway
AP	Albemarle-Pamlico
AR	artificial reef
ASA(CW)	Assistance Secretary of the Army for Civil Works
AST	above-ground storage tank
ASTM	American Society for Testing and Materials,
ATR	Agency Technical Review
BA	Biological Assessment
BBSPP	Bogue Banks Shore Protection Project
BC	berm crest
BMAP	Beach Morphology Analysis Program
BO	Biological Opinion
BOEMRE	Bureau of Ocean Energy Management, Regulation and Enforcement
CAA	Clean Air Act
CALO	Cape Lookout National Seashore
CAMA	Coastal Area Management Act
CBRA	Coastal Barrier Resources Act
CBRS	Coastal Barrier Resources System
CEDEP	Corps of Engineers Dredging Estimating Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulations
CHIRP	Compressed High Intensity Radar Pulse
COLREGS	International Regulations for Preventing Collisions at Sea
CPT	Channel Portfolio Tool
CPU	cone penetrometer units
CWB	colonial waterbird
cy	cubic yards
CZMA	Coastal Zone Management Act
DAP	diammonium phosphate
DB	dune base
DE	Delaware
DEIS	Draft Environmental Impact Statement
DMMP	Dredged Material Management Plan

DN	dune
DOQQ	Digital Orthophoto Quarter Quads
DWT	dead weight tons
EA	Environmental Assessment
EA/FONSI	Environmental Assessment and Finding of No Significant Impact
EC	Engineer Circular
EDR	E Data Resources, Inc.
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
elev	elevation
EP	Engineer Pamphlet
EPM	Equilibrium Profile Method
ER	Engineer Regulation
ERDC	Engineering Research and Development Center
FEMA	Federal Emergency Management Agency
FONSI	Finding of No Significant Impact
FSC	Federal species of concern
FT	feet
GI	General Investigation
GIS	Geographic Information System
G.S.	General Statute
HAPC	Habitat Areas of Particular Concern
H.D.	House Document
HMTF	Harbor Maintenance Trust Fund
HQW	High Quality Water
HTRW	hazardous, toxic and radioactive wastes
IEPR	Independent External Peer Review
IH	Inner Harbor
IOP	Interim Operations Plan
ITM	Inland Testing Manual
LLC	Limited Liability Corporation
LST	landing ship, tank
MANLAA	may affect not likely to adversely affect
MALAA	may affect likely to adversely affect
MAP	monoammonium phosphate
MCACES	Microcomputer Aided Cost Engineering System
MDS	maximum density separators
MHC	Morehead City Harbor
mhw	mean high water

mlw	mean low water
mllw	mean lower low water
MMS	Minerals Management Service
MOA	Memorandum of Agreement
MPRSA	Marine Protection, Research, and Sanctuaries Act
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MSL	mean sea level
NAVD88	North American 1988 Vertical Datum
NC	North Carolina
NCAC	North Carolina Administrative Code
NCARP	North Carolina Artificial Reef Project
NCCMP	North Carolina Coastal Management Program
NCDCM	North Carolina Division of Coastal Management
NCDENR	North Carolina Department of Environment and Natural Resources
NCDMF	North Carolina Division of Marine Fisheries
NCDWQ	North Carolina Division of Water Quality
NCSPA	North Carolina State Ports Authority
NEC	not elsewhere classified
NED	National Economic Development
NEPA	National Environmental Policy Act
NLAM	not likely to adversely modify
NMFS	National Marine Fisheries Service
NOAA	National Oceanographic and Atmospheric Administration
NOI	Notice of Intent
NPS	National Park Service
NRC	National Research Council
NSP	nearshore placement
NTU	nephelometric turbidity unit
O & M	Operations and Maintenance
OCS	Outer Continental Shelf
ODMDS	Ocean Dredged Material Disposal Site
OEC	Outer Entrance Channel
OH	Outer Harbor
OMB	Office of Management and Budget
ORV	off road vehicles
ORW	Outstanding Resource Water
OW	overwash
PA	Preliminary Assessment
PL	Public Law

PDT	Project Delivery Team
PGL	Policy Guidance Letter
PNA	Primary Nursery Area
ppt	parts per thousand
QAR	Queen Anne's Revenge
RFQ	Request for Qualifications
RSM	Regional Sediment Management
SAD	South Atlantic Division
SAFMC	South Atlantic Fishery Management Council
SARBA	South Atlantic Regional Biological Assessment
SAV	submerged aquatic vegetation
SEAMAP	Southeast Monitoring and Assessment Program
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SUP	Special Use Permit
T & E	Threatened and Endangered Species
TR	trough
UAB	Underwater Archaeology Branch
USACE	U. S. Army Corps of Engineers
USC	U. S. Code
USCG	U.S. Coast Guard
USFWS	U. S. Fish and Wildlife Service
UST	underground storage tank
USVI	U. S. Virgin Islands
UTM	Universal Transverse Mercator
VIMS	Virginia Institute of Marine Science
WCSC	Waterborne Commerce Statistics Center
WRDA	Water Resources Development Act
μPa	micropascal

1 STUDY BACKGROUND

1.1 Purpose and Need

The U. S. Army Corps of Engineers ( ) Engineering Regulation (ER) 1105-2-100 provides that the USACE Districts develop a Dredged Material Management Plan (DMMP) for all federal harbor projects where there is an indication of insufficient disposal capacity to accommodate maintenance dredging for the next 20 years.

In 1997, a Preliminary Assessment (PA) for Morehead City Harbor was completed by the USACE, Wilmington District. The purpose of the PA was to document the continued viability of the Port and to determine whether there is dredged material disposal capacity sufficient to cover at least 20 years of maintenance dredging. The PA concluded that there were no significant problems to the continued maintenance of the Morehead City Harbor project, therefore, a DMMP was not recommended at that time. However, since 1997, changes have occurred regarding the management of dredged material from Morehead City Harbor. In the past, capacity in the Brandt Island confined disposal site was periodically restored when the material from Brandt Island was pumped to the beach. Because pumpouts are no longer a feasible option, since 2005 (the last pumpout), only fine-grained material has been disposed of in Brandt Island. These changes are discussed in more detail in Section 2.1 (Existing Conditions). To address these changes and the implications for future management of the Harbor, development of a formal dredged material management plan is now warranted. The DMMP meets the requirements of ER 1105-2-100.

As discussed in more detail below, the National Park Service (NPS) is a cooperating agency for this DMMP. The proposed action of the NPS may be to issue one or more special use permits (or similar instrument) allowing and governing the deposition of dredged sediment on Shackleford Banks, within the boundary of Cape Lookout National Seashore, if deemed appropriate by the NPS.

1.2 Authority and Scope

The U. S. Army Corps of Engineers (USACE) Appendix E, Section II, paragraph E-15 of ER 1105-2-100 provides that a DMMP be developed for federal navigation projects if a Preliminary Assessment does not demonstrate sufficient capacity to accommodate maintenance dredging for the next twenty years. The DMMP is a planning document that ensures maintenance-dredging activities are performed in an environmentally acceptable manner, use sound engineering techniques, and are economically justified. A DMMP addresses dredging needs, disposal capabilities, capacities of disposal/placement areas, environmental compliance requirements, potential for beneficial use of dredged material and indicators of continued economic justification. Beneficial use is defined as utilizing dredged sediments as resource materials in productive ways. Dredged Material Management Plans ensure that sufficient disposal capacity is available for at least the next 20 years and should be updated periodically to identify any potentially changed conditions.

In addition to ER 1105-2-100, three Policy Guidance memoranda provide additional guidance regarding the preparation of DMMPs. They are: 1) Policy Guidance Letter (PGL) No. 40, dated March 1993, Development and Financing of Dredged Material Management Studies; 2) PGL No. 42, dated March 1993, Additional Guidance on Financing of Dredged Material Management Studies and 3) PGL No. 47, dated April 1998, Cost Sharing for Dredged Material Disposal Facilities and Dredged Material Disposal Facility Partnerships.

Pursuant to PGL 40, the federal interest in continued operation and maintenance of an existing federal project for its navigation purpose is the base disposal plan ("base plan"), which is defined by the least cost plan for dredged material management that is consistent with sound engineering practice and meeting the environmental standards established by Section 404 of the Clean Water Act of 1972 or Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972, as amended. Pursuant to 33 CFR 335.4, USACE undertakes operations and maintenance activities where appropriate and environmentally acceptable. All practicable and reasonable alternatives are fully considered on an equal basis. This includes the discharge of dredged or fill material into waters of the U.S. or ocean waters in the least costly manner, at the least costly and most practicable location, and consistent with engineering and environmental requirements. Each management plan must establish this base plan using the procedures in 33 CFR Parts 334, 335, 336, and 337.

Federal funds for DMMP studies are limited to establishment of the base plan. However, pursuant to ER 1105-2-100, all dredged material management studies are required to include an assessment of potential beneficial uses for environmental purposes including fish and wildlife habitat creation, ecosystem restoration and enhancement and/or hurricane and storm damage reduction. Study activities related to dredged material management for the federal project, but not required for continued maintenance dredging and dredged material disposal, will not be included in management plan studies unless funded by others (Appendix E, ER 1105-2-100). Therefore, studies of measures beyond establishment of the base plan, are outside the scope of this DMMP. Those types of studies, as specifically mentioned where applicable throughout the text of this DMMP, may be pursued through other subject-specific authorities.

The Morehead City Harbor federal navigation project is the subject of this DMMP. Details regarding the Morehead City Harbor project authority and history are provided below in Section 2.1 (Existing Conditions).

1.3 DMMP Process

The DMMP for the Morehead City Harbor project has been developed using a consistent and logical procedure by which dredged material management measures and alternatives have been identified, evaluated, screened, and recommended so that dredged material disposal operations are conducted in a timely, environmentally sensitive, and cost-effective manner. The overall framework for the Morehead City Harbor DMMP development is shown below in Figure 1-1.

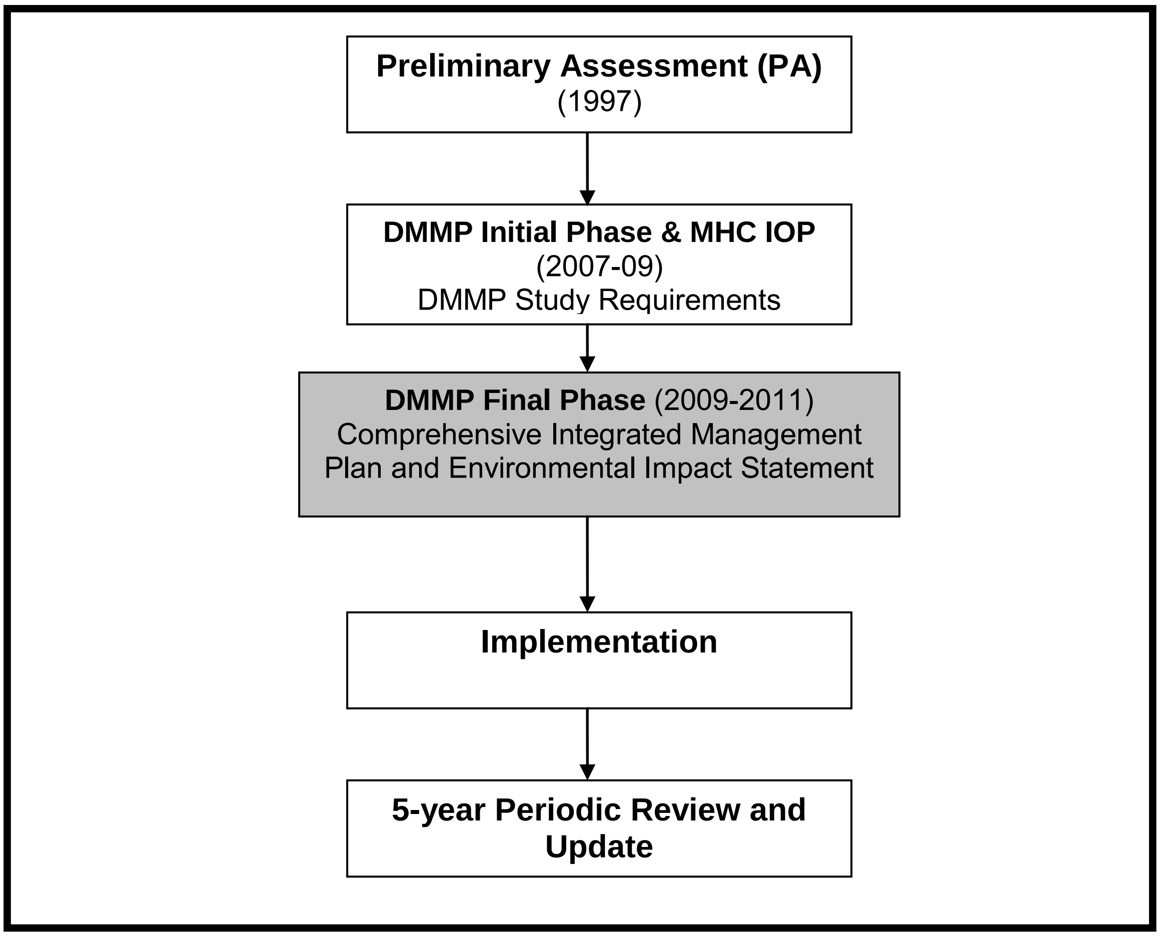


Figure 1-1. Morehead City Harbor DMMP Framework

As discussed above, due to changes in disposal practices for maintenance dredged material from Morehead City Harbor, development of a formal dredged material management plan is warranted. The initial phase of the DMMP began in 2007 and included the identification of dredged material management problems and opportunities, the procedure used to identify measures, the methodology used to select measures for further analysis, work tasks and the costs and schedule to perform those tasks. Also, during this phase an integrated Interim Operations Plan and Environmental Assessment and Finding of No Significant Impact (IOP) were completed for Morehead City Harbor (USACE 2009). The purpose of the IOP was to address modifications to the existing Morehead City Harbor dredged material disposal practices for an interim period while the Morehead City Harbor DMMP was being developed. The final phase of the Morehead City Harbor DMMP began in the winter of 2009 and the final product of this phase is an integrated DMMP and Environmental Impact Statement. Subsequent phases of the DMMP process include implementation of the DMMP with periodic review and update.

1.4 Study Area Description and Location

Morehead City Harbor is a federal navigation project located in the Town of Morehead City, North Carolina, approximately 3 miles from the Atlantic Ocean through Beaufort Inlet (Figure 1-2). The authorized Morehead City Harbor project is divided into two parts: The deep draft portion and the shallow draft portion. As shown on Figure 1-4, the deep draft portion consists of three main ranges or sections: the Inner Harbor, which includes the Northwest, West, and East Legs and North Range C; the Outer Harbor, which includes South Range C, Range B, the Cutoff and Range A out to Station 110+00; and the Outer Entrance Channel, which is made up of the seaward end of Range A (from station 110+00 out); the shallow draft portion includes 3 additional ranges: the Entrance Channel, Waterfront Channel and Bogue Sound Channel. In addition to the Morehead City Harbor navigation channels, the DMMP study area also includes the adjacent mainland area, the beaches of Bogue Banks and Shackleford Banks, the nearshore Atlantic Ocean off of Bogue Banks and Shackleford Banks (ebb tide delta), the Environmental Protection Agency (USEPA) designated Ocean Dredged Material Disposal Site (ODMDS), and the existing disposal sites of Brandt Island, Marsh Island and Radio Island (Figures 1-3 through 1-5).

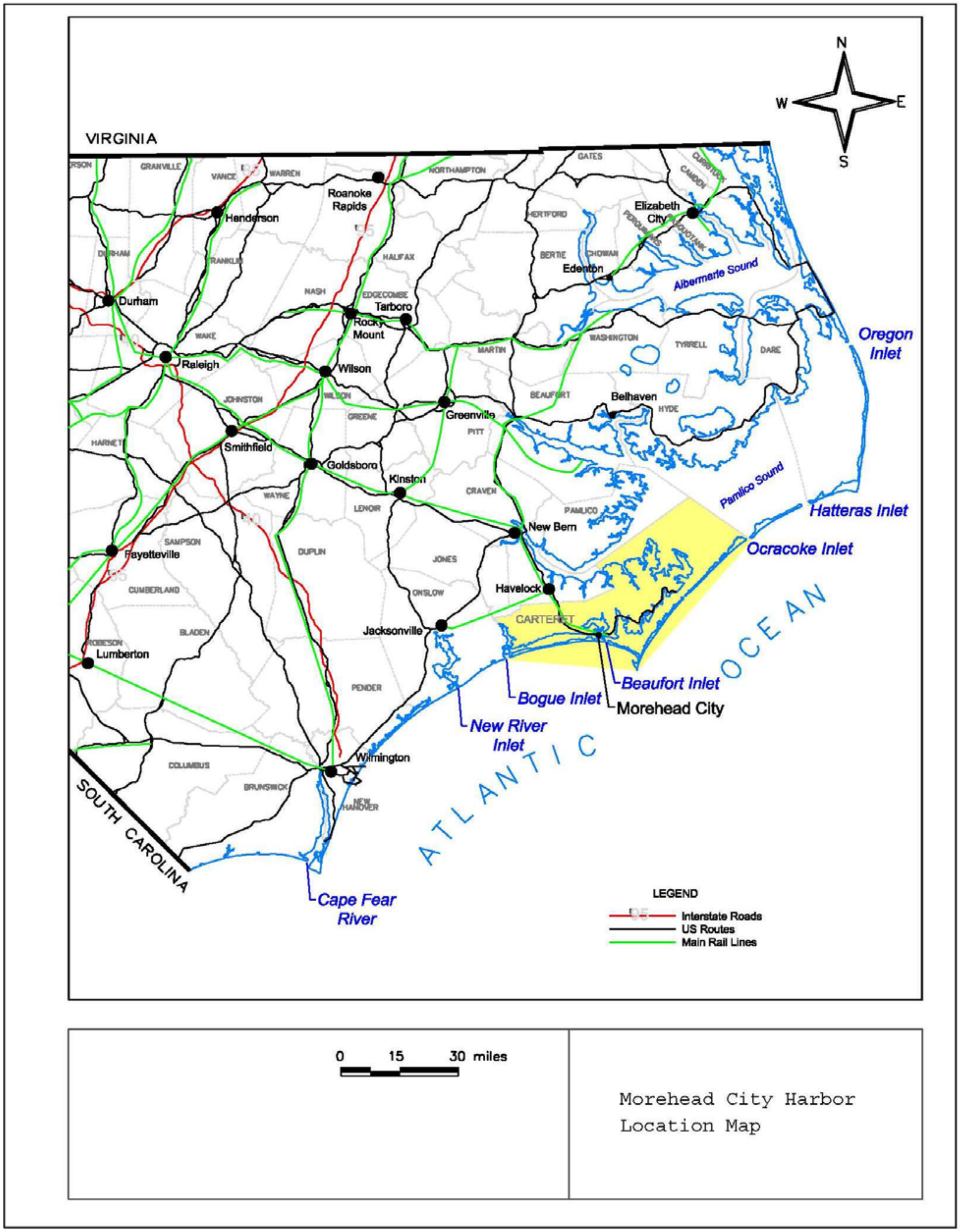


Figure 1-2. Morehead City Harbor Location Map

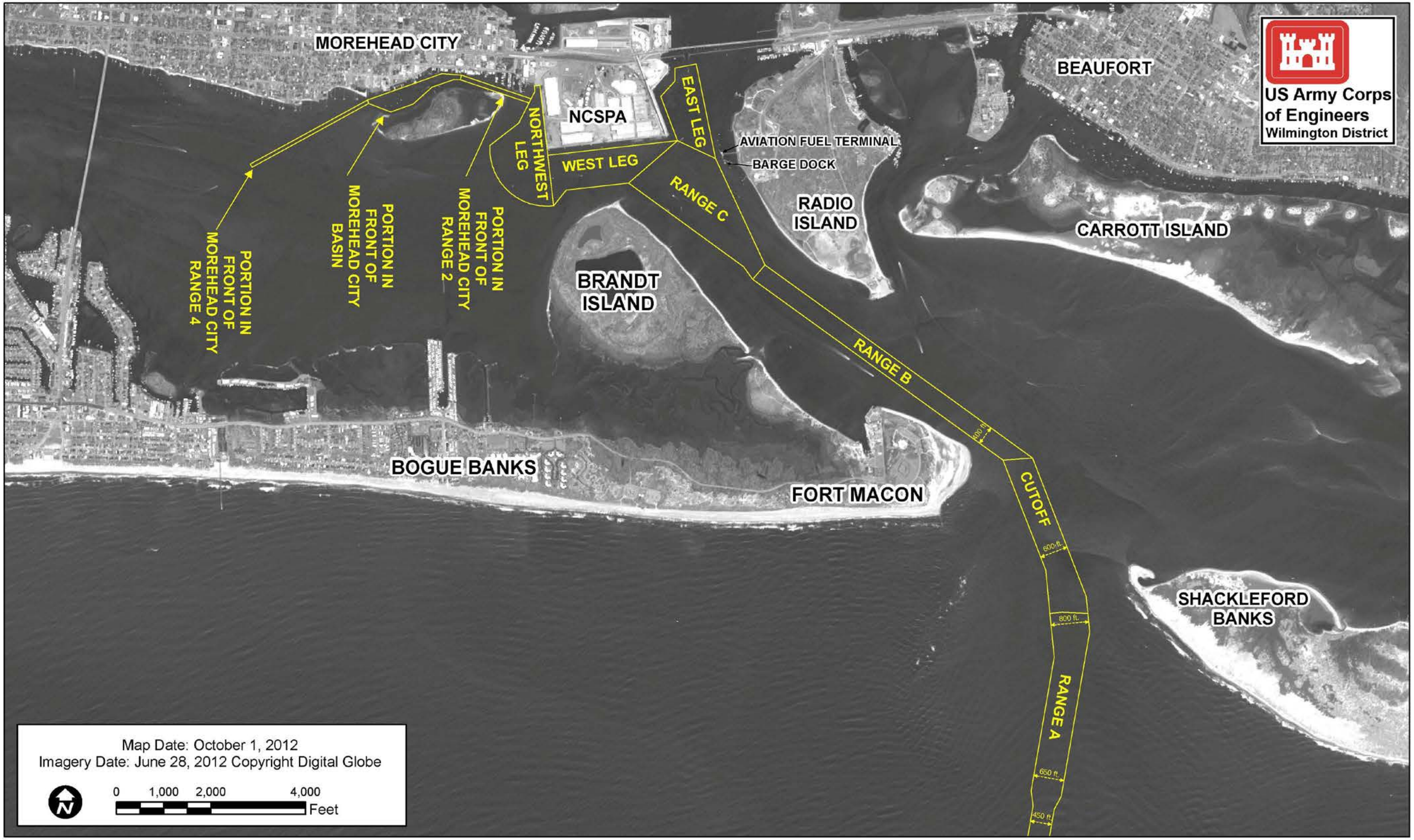


Figure 1-3. Morehead City Harbor Federally Authorized Navigation Project

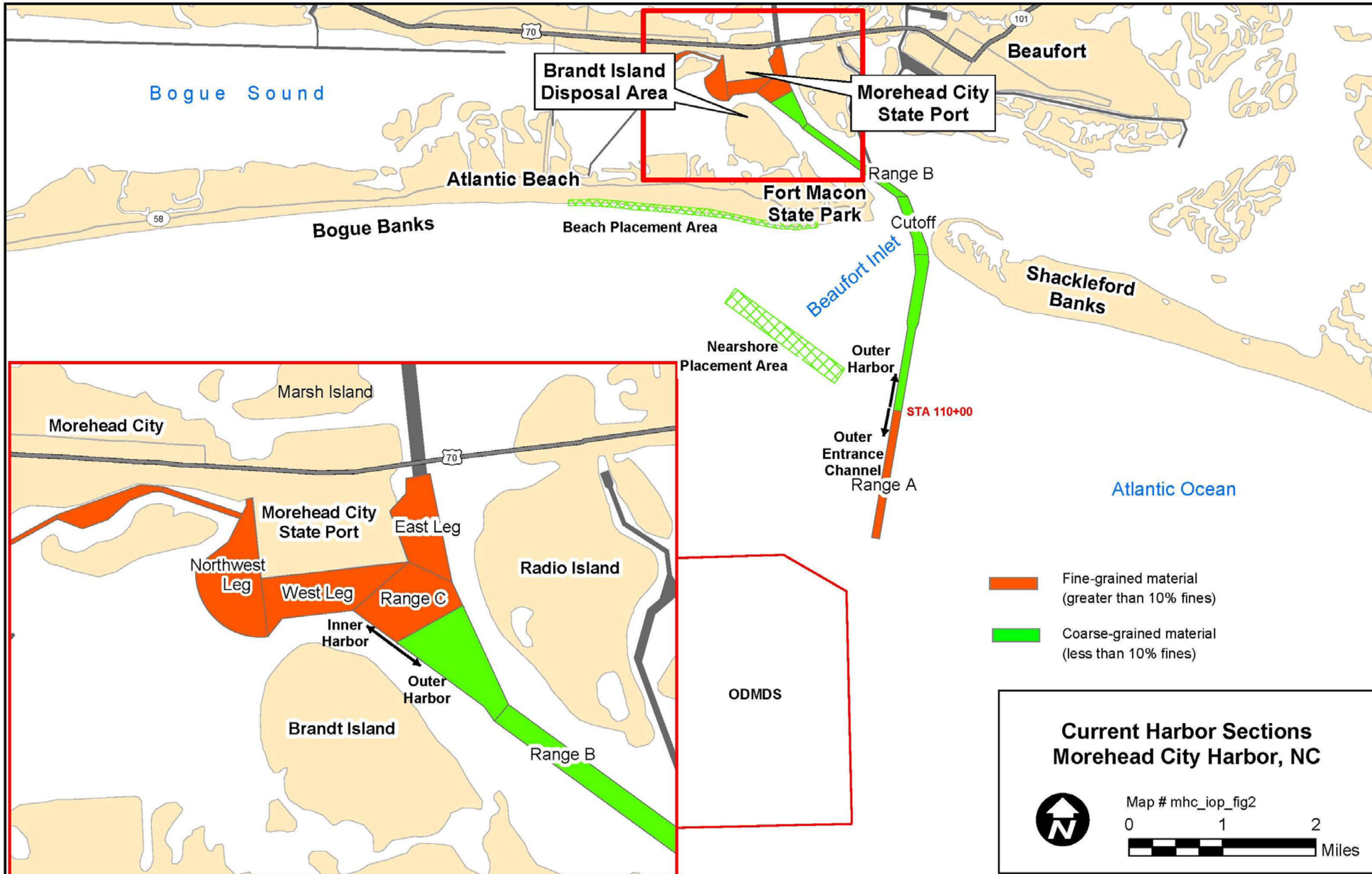


Figure 1-4. Morehead City Harbor Navigation Channel Sections

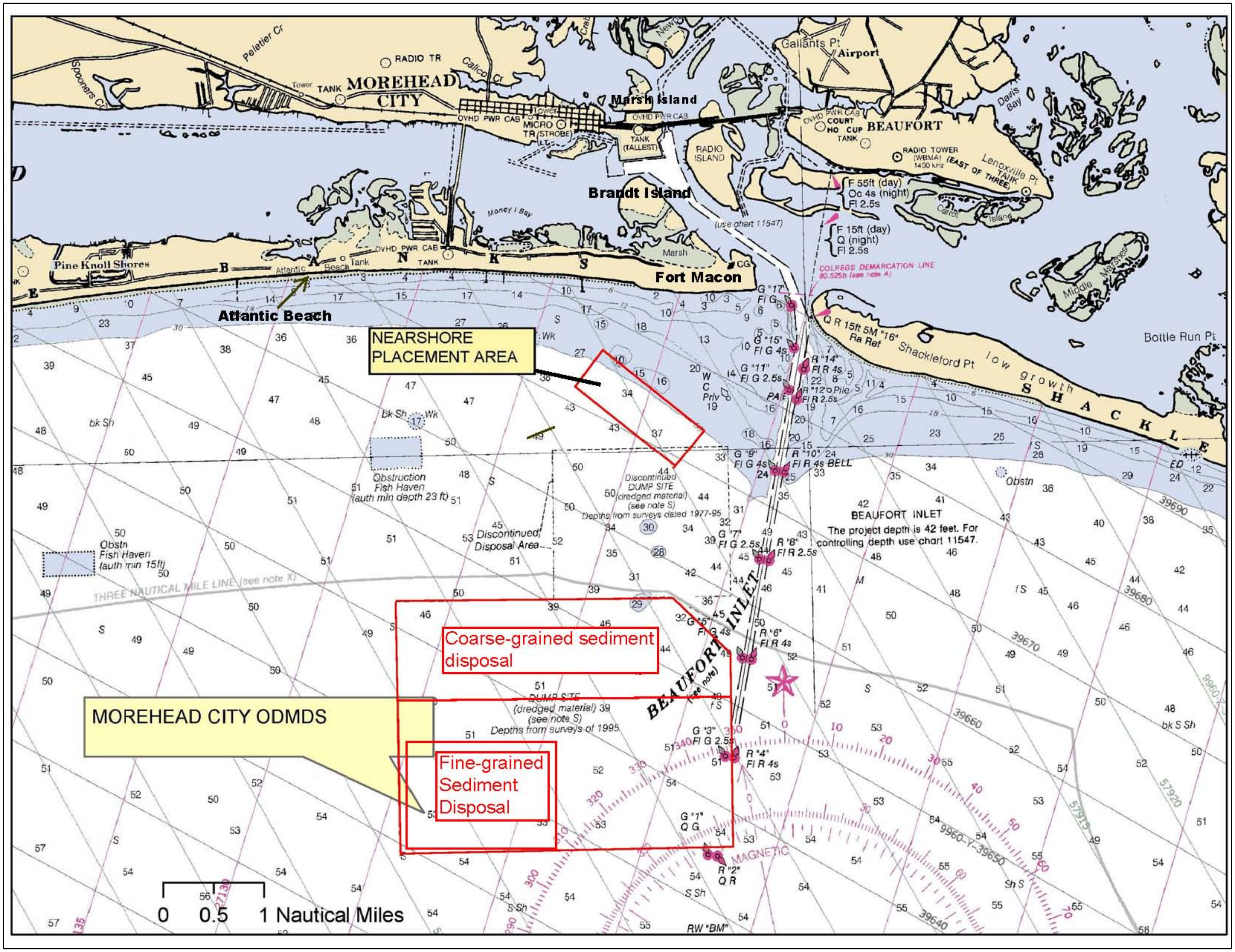


Figure 1-5. Morehead City Harbor DMMP Study Area

1.5 Incorporation by Reference

The USACE has produced a number of environmental and planning reports which describe the Morehead City Harbor federal navigation project, its ongoing and proposed improvements, the details of dredging and disposal operations required for its construction and maintenance, and the environmental aspects of the project. These documents (i.e., items a to l below) were used in the writing and development of the DMMP and are cited in the References in Section 13 . Eleven of these reports, which contain extensive background information, are listed below and are incorporated by reference.

a. U.S. Army Corps of Engineers, Wilmington District. May 1976. Final Environmental Statement, Morehead City Harbor, North Carolina.

b. U.S. Army Corps of Engineers, Wilmington District. May 1976. Morehead City Harbor, North Carolina, General Design Memorandum.

c. U.S. Army Corps of Engineers Wilmington District. October 1983. Morehead City Harbor Beach Disposal, Carteret County, North Carolina, Environmental Assessment.

d. U.S. Army Corps of Engineers, Wilmington District. June 1990 and revised December 1990. Feasibility Report and Environmental Assessment, Morehead City Harbor Improvement, Morehead City, North Carolina.

e. U.S. Army Corps of Engineers, Wilmington District. March 1992. Environmental Assessment and Finding of No Significant Impact, Design Memorandum, Morehead City Harbor Improvement, Morehead City, North Carolina, Project Modifications.

f. U.S. Army Corps of Engineers, Wilmington District. January 1993a. Environmental Assessment and Finding of No Significant Impact, Disposal of Dredged Material on the Ocean Beach of Bogue Banks from the Combined Maintenance Dredging and Deepening of Morehead City Harbor Inner Harbor Navigation Channels and Pumpout of Brandt Island Upland Diked Disposal Site, Carteret County, North Carolina.

g. U.S. Army Corps of Engineers, Wilmington District. April 1993b. Finding of No Significant Impact, Disposal of Dredged Material on the Ocean Beach of Bogue Banks from the Combined Maintenance Dredging and Deepening of Morehead City Harbor, Inner Harbor Navigation Channels, Bulkhead Channel, U.S. Navy Landing Ship Tank (LST) Ramp, and Pumpout of Brandt Island Upland Diked Disposal Site, Carteret County, North Carolina.

h. U.S. Army Corps of Engineers, Wilmington District. August 1994a. Environmental Assessment, Designation and Use of a Placement Area for

Underwater Nearshore Berm, Morehead City Harbor Project, Morehead City, North Carolina.

i. U.S. Army Corps of Engineers, Wilmington District. December 1994b. Finding of No Significant Impact, Designation and Use of a Placement Area for Underwater Nearshore Berm, Morehead City Harbor Project, Morehead City, North Carolina.

j. U.S. Army Corps of Engineers. 2001. "Section 111 Report, Morehead City Harbor/Pine Knoll Shores North Carolina", U.S. Army Corps of Engineers, Wilmington District, South Atlantic Division

k. U.S. Army Corps of Engineers, Wilmington District. May 2003. Draft Evaluation Report and Environmental Assessment, Morehead City Harbor Section 933, Carteret County, North Carolina.

l. U.S. Army Corps of Engineers, Wilmington District. June 2009. Environmental Assessment and Finding of No Significant Impact, Interim Operations Plan. Morehead City Harbor, North Carolina.

The Integrated DMMP and DEIS will provide information that is immediately pertinent to the new proposed actions and will not repeat the information incorporated by reference.

2 DESCRIPTION OF EXISTING CONDITIONS, FUTURE WITHOUT PROJECT CONDITIONS, PROBLEMS, OPPORTUNITIES, ASSUMPTIONS, GOALS, AND CONSTRAINTS

2.1 Existing Conditions

Physical Harbor Conditions. Construction of Morehead City Harbor was originally authorized by the 1910 Rivers and Harbors Act (H.D. 649, 61st Cong. 2nd sess). The original authorization allowed for construction of a navigation channel 10 feet deep by 100 feet wide through Beaufort Inlet to the Morehead City Waterfront; thence a channel 10 feet deep by 200 feet wide along the Morehead City wharves. The project's channel dimensions were modified several times, including expansion of the project to provide navigation channels and turning basins which service the North Carolina State Ports Authority (NCSPA) facilities, by the following Congressional Documents: 1930 Rivers and Harbors Act (H.D. 105, 70th Cong. 1st sess.), 1937 Senate Committee Print (74th Cong. 1st sess.), 1958 River and Harbor Act (S.D. 54, 84th Cong., 1st sess.), the River and Harbor Act of December 31, 1970 (H.D. 92-170, 92nd Cong. 1st sess.), the Water Resources Development Act of 1986, the Water Resources Development Act of 1992, and Section 509(a)(17) of the Water Resources Development Act of 1996.

The current federal authorization for the Morehead City Harbor project consists of both deep draft and shallow draft portions. The deep draft portion of the project provides navigation channels from the deep water of the Atlantic Ocean to the NCSPA facilities.

The shallow draft portion of the project provides for navigation channels from the waterfront docks at Downtown Morehead City to the deep draft portion of the project. All channels, including channel dimensions and cross-sections, within the Morehead City Harbor project are shown on Figure 1-3. The average tidal range in the Harbor, which is the vertical difference between high tide and the succeeding low tide, is about 3.1 feet.

In addition to the federally maintained navigation channels, the State of North Carolina (Project Sponsor) is responsible for maintenance dredging within the non-federal berthing areas. Non-federal berthing Areas 1-3, 4-7, Barge Dock and Aviation Fuel Terminal are shown on Figure 1-3. Berths 8 and 9 are part of the federally authorized project and therefore are federally maintained. The principal user of these berths is the U. S. Military. All berthing areas (federal and non-federal) were considered during development of the DMMP.

<u>Morehead City Harbor, NC – Deep Draft portion</u>

Range A:	47-ft deep mllw by 450 to 650 feet wide from deep water in the Atlantic Ocean to Beaufort Inlet; step cut as shown in Figure 1-3 (see Range A cross-section inset)
Cut-Off:	45 feet deep mllw with varying width; connecting Range A with Range B.
Range B:	45 feet deep mllw by 400 feet wide; connecting the Cut-off Channel with Range C.
Range C:	45 feet deep mllw by varying width of approximately 400 to 1,350 feet; connecting Range B with East and West Legs. (includes a turning basin in Range C and a portion in the West Leg that is 1,350 feet in diameter);
East Leg:	45 feet deep mllw by a varying width of approximately 800 to 1,000 feet; connecting Range C with the non-federal berthing area, located east of the NCSPA facility.
West Leg:	35 feet deep mllw by approximately 780 feet wide; connecting Range C with the non-federal berthing area, located south of the NCSPA facility and with the Northwest Leg.
Northwest Leg:	35 feet deep mllw by approximately 1,200 feet wide; Note: Federal authorization of the Northwest Leg extends to the West facing bulkhead of the NCSPA facility (i.e., there is no non-federal berthing area located west of the NCSPA facility).

Morehead City Harbor, NC – Shallow Draft portion

Entrance Channel:	12 feet deep mllw by 100 feet wide from the Northwest Leg to Sixth Street along the Morehead City Waterfront
Waterfront Channel:	12 feet deep mllw by 200 to 400 feet wide from Sixth Street to 10th Street along the Morehead City Waterfront
Bogue Sound Channel:	6 feet deep mllw by 75 feet wide from 10th Street to the Atlantic Intracoastal Waterway in Bogue Sound

As shown in Figures 1-3 and 1-4, and described above, the Morehead City Harbor navigation project consists of several navigation channels or ranges. Dredging methods and disposal options within each range depend on the channel location and the *in situ* material characteristics. Based on these sediment characteristics and potential disposal locations, in the past the channels or ranges are grouped into sections based on two categories of dredged material: 1) fine-grained material less than 90% sand (not suitable for beach disposal) and 2) coarse-grained material greater than or equal to 90% sand (suitable for beach disposal). The Inner Harbor (Northwest Leg, West Leg, East Leg and North Range C) and the Outer Entrance Channel (Range A, beyond Station 110+00) contained fine-grained material and the Outer Harbor (South Range C, Range B, Cutoff, Range A out to Station 110+00) contained the course-grained material that is suitable for beach disposal.

Below is a summary of current dredging methods and disposal locations for maintenance dredging activities within the Harbor. Table 2-1, below, contains a summary of all current maintenance dredging activities for the deep draft portion of the Harbor. The shallow draft portion of the Morehead City Harbor has not been dredged in over 15 years, therefore, the table below does not include these ranges. Although these channels were considered during the development of alternatives for the DMMP, they are dredged so infrequently and contain such small quantities relative to overall project quantities (~50,000 cubic yards of fine-grained material and ~50,000 cubic yards of coarse-grained sand) that they were not included in the detailed analyses conducted for all other portions of the Harbor. Table 2-1 includes dredging and disposal methods, sediment volumes, dredging frequency, and sediment classification for the various Morehead City Harbor ranges. Sediment classification is based on the Unified Soils Classification System. Sand is described as a material where 50% or more of the material lies between the number 4 sieve (4.76 mm) and the number 200 sieve (0.074mm). Sand removed from navigation channels is acceptable for beach disposal when it has less than 10% passing the number 200 sieve. Table 2-1 lists the Harbor sediment characteristics (% sand) by range.

Harbor Section	Range	Estimated Dredging Quantity (Cubic Yards/Year)	Frequency of Dredging (years)	Disposal/Placement Location	Dredge Type	Sediment Classification (% Sand)
Inner Harbor	Northwest Leg	60,900	2 to 3	ODMDS/Brandt Island	Bucket/Pipeline	23% to 77%
	West Leg	23,200	2 to 3	ODMDS/Brandt Island	Bucket/Pipeline	88% to 94%
	East Leg	57,200	2 to 3	ODMDS/Brandt Island	Bucket/Pipeline	40% to 95%
	Partial Range C	60,900	2 to 3	ODMDS/Brandt Island	Bucket/Pipeline	80% to 99%
Outer Harbor	Partial Range C	22,300	2 to 3	Beach/NSP*/ODMDS	Pipeline/Hopper	≥90%
	Range B	45,400	2	Beach/NSP*/ODMDS	Pipeline/Hopper	≥90%
	Cutoff	182,500	1	Beach/NSP*/ODMDS	Pipeline/Hopper	≥90%
	Range A out to Station 110+00	491,600	1	Beach/NSP*/ODMDS	Pipeline/Hopper	≥90%
Outer Entrance Channel	Range A, beyond Sta. 110+00	56,000	1 to 3	ODMDS	Hopper	47% to 99%
	Total	**1,000,000**				
ODMDS: Ocean Dredged Material Disposal Site NSP: Nearshore Placement Area (*During adverse weather conditions, the contractor was given the option of placing material in the ODMDS) Beach: Fort Macon State Park/Atlantic Beach						

Table 2-1. Summary of Dredging and Disposal Practices for Morehead City Harbor from 1997 through 2008.

As shown in Table 2-1, annual maintenance dredging is required in some ranges within the Morehead City Harbor project to provide unrestricted navigation for ocean-going vessels calling upon the Harbor. On average, shoaling rates are such that the Inner Harbor navigation channels require maintenance dredging every two to three years, while the Outer Harbor and Outer Entrance Channel require maintenance dredging on an annual basis. Note: Dredging quantities shown above are annual quantities; and detailed documentation of dredging quantities, by range, did not begin until 1997.

Inner Harbor. Maintenance dredging in the Inner Harbor has historically been accomplished by hydraulic pipeline dredge with disposal/placement on either the diked disposal area at Brandt Island or the beaches of Fort Macon State Park and Atlantic Beach. Brandt Island has been used since 1955 and from 1978 through 2005 the majority of Inner Harbor dredged material was temporarily disposed of in Brandt Island and periodically pumped onto the adjacent beaches of Fort Macon State Park and Atlantic Beach. This beach disposal of material compensated for any potential shoreline impacts associated with changes in sediment transport attributable to the federal navigation project (USACE 2001). The most recent Brandt Island pumpout (2005) was problematic in that it included disposal of an unacceptable amount of fine-grained material onto the beach. This occurrence, along with recent USACE geotechnical investigations, indicates that Brandt Island and portions of the Inner Harbor contain material unfit for beach disposal. As a result, since 2005, only fine-grained dredged material has been disposed of in Brandt Island and, due to the lack of accessible coarse-grained material in Brandt Island, there are no plans for future pumpouts from Brandt Island to the beach. Since the 2005 disposal, the Wilmington District performed extensive geotechnical sampling within the project's navigation channels (in 2006 and 2008) to better define the characteristics of the shoaled material and a summary of this analysis is included in Table 2-1.

Outer Harbor and Outer Entrance Channel. The Outer Harbor and Outer Entrance Channel maintenance dredging have historically been accomplished by hopper or pipeline dredge on an annual basis. Dredged material from the Outer Harbor is typically placed in the approved nearshore placement area (Figure 1-4) or on the shoreline at Fort Macon State Park and Atlantic Beach. During inclement weather, when conditions render it unsafe to navigate in the nearshore area, material has also been disposed of in the United States Environmental Protection Agency (USEPA) designated Morehead City Ocean Dredged Material Disposal Site (ODMDS) within the area designated for coarse-grained material. The Outer Entrance Channel material, which is fine-grained, is disposed of in the ODMDS within the area designated for fine-grained material. For more information regarding management of the ODMDS, see Section 3.2.3 (Ocean Dredged Material Disposal Site (ODMDS)).

Current Management of Morehead City Harbor Navigation Channels (Interim Operations Plan). Until the DMMP is finalized in the winter of 2014, Morehead City Harbor will be maintained in accordance with the IOP, with first implementation of the DMMP likely being in fiscal year 2015. The IOP was structured so the Morehead City

Harbor maintenance dredging would occur on a three-year dredging rotation. The IOP was developed using past dredging quantities, recent geotechnical data, and current channel and disposal area conditions. The following paragraphs provide a detailed description of the dredging operations proposed for the three year maintenance dredging cycle. Please note that all quantities provided below are estimates based upon historic shoaling and dredging quantities. Actual quantities will vary. The operations detailed below are anticipated to occur within applicable environmental dredging and disposal windows, as follows:

- <u>Hopper dredging</u>: January 1 to March 31 (Wilmington District protocol for sea turtles to minimize dredging impacts).
- <u>Bucket and barge dredging</u>: No window with the exception of an Inner Harbor dredging window that is being discussed with NCDMF.
- <u>Pipeline dredging</u>: No window
- <u>Disposal</u>: November 16 to April 30 for beach disposal on Bogue Banks; November 16 to March 31 for beach disposal on Shackleford Banks due to potential for nesting birds; January 1 to March 31 for nearshore placement; and September 1 to March 31 for disposal on Brandt Island, if needed to avoid impacts to nesting birds.

Every effort will be made to accomplish maintenance of the Morehead City Harbor project within these windows. Should circumstances require that work be accomplished outside of the aforementioned windows, the USACE will coordinate the action with all appropriate resource agencies prior to start of work.

The 2003 through 2008 sediment sampling efforts identified that the majority of Inner Harbor material consists of fine-grained material which ranges from 23% to 99% sand with the majority of material being less than 90% sand. As a general rule, disposal of dredged material on beaches is limited to that material which is at least 90% sand. Inner Harbor material is less than 90 % sand and therefore not suitable for disposal onto adjacent shorelines. Sampling also showed that the majority of the shoaled material located in the Outer Harbor consists of coarse-grained material suitable for beach or nearshore placement; with the exception of a small amount of material in the Outer Entrance Channel from station 110+00 seaward (Figure 1-4). A summary of these sampling efforts and the results are provided in Section 4.1 (Sediment and Sand Resources) and in Appendix B of this report. The inability to offset project impacts through Brandt Island pumpouts led to the revised management strategy for the Morehead City Harbor project (IOP)(Appendix A). The Environmental Assessment and Finding of No Significant Impact (EA/FONSI) for the IOP was completed in June 2009 and it addressed modifications to the existing Morehead City Harbor dredged material disposal practices for an interim period while the Morehead City Harbor DMMP is being developed. The IOP is described as follows:

Interim Operations Plan Year-1: Approximately 1.1 million cubic yards of coarse-grained material would be removed from the Morehead City Harbor Outer Harbor by pipeline dredge, and disposed of along the shorelines of Fort Macon State Park and Atlantic Beach.

Interim Operations Plan Year-2: Approximately 700,000 cubic yards of fine-grained material would be removed from the Morehead City Inner Harbor by hydraulic pipeline dredge with disposal in the Brandt Island confined disposal area, or by bucket and barge with disposal in the ODMDS. Approximately 250,000 cubic yards of coarse-grained material would be removed by hopper dredge from the Outer Harbor and placed within the existing nearshore placement area. Maintenance dredging in the Outer Harbor is anticipated to be minimal due to pipeline maintenance dredging performed in Year-1.

Interim Operations Plan Year-3: Approximately 750,000 cubic yards of coarse-grained material would be removed from the Morehead City Harbor Outer Harbor with a hopper dredge and placed within the existing nearshore placement area. Fine-grained material from the Outer Entrance Channel would be dredged with the same hopper dredge and disposed of within the ODMDS. Approximately 100,000 cubic yards of dredged material may also be removed by the same hopper dredge from portions of the Morehead City Harbor Inner Harbor and disposed of within the ODMDS.

<u>Maintenance of Other Federal Channels in the Project Vicinity</u>. Dredged material originating from Beaufort Harbor has a variety of material characteristics depending on where it is in the channel and has historically been disposed of in the following locations: North Radio Island, Carrot Island, and the adjacent shoreline of Bogue Banks. These disposal areas will continue to be utilized for disposal of dredged material from Beaufort Harbor.

Dredged material originating from the southern Core Creek reaches of the Atlantic Intracoastal Waterway (AIWW) has historically been disposed of within North Radio Island. North Radio Island will continue to be utilized for AIWW dredged material.

Dredged material originating from the Atlantic Beach Channel project has historically been disposed of within Brandt Island upland disposal area. The dredging frequency for the Atlantic Beach Channel project is approximately once every 10 years, with an approximate quantity of only 30,000 cubic yards dredged each time.

<u>Use of Disposal Sites by Other Government Entities</u>. Maintenance dredging and disposal paid for by other government entities may periodically be included in USACE dredging contracts. Dredging done by another government agency and included in a USACE contract is typically addressed in a Memorandum of Agreement (MOA) and these disposal volumes were considered in the development of the DMMP. These areas within the Morehead City Harbor DMMP study area include the non-federal berthing areas mentioned previously as well as the Fort Macon Coast Guard Station. About 15,000 cubic yards of material is removed annually from the non-federal berthing areas and approximately 70,000 cubic yards of fine-grained material are dredged every 6 years from the Coast Guard Station. Dredged material from these areas has historically been disposed of in Brandt Island, however, based on the results of sediment evaluations (pursuant to Section 103 of the Marine Protection Research and

Sanctuaries Act (MPRSA)), material could go to the ODMDS and may do so during future dredging events. The small amount of material historically dredged from the non-federal berthing areas and the Coast Guard channel would have a negligible effect on the capacity of the ODMDS and therefore would not impact the long-term maintenance of the Morehead City Harbor navigation project.

Economic Conditions. Federal dredging projects in Morehead City Harbor began in 1910 with a 20' deep channel. Since then the Harbor has been studied and deepened four times to accommodate deeper draft vessels and changes in cargo. The last deepening project was completed in 1994 when the project was deepened to its currently authorized depths. The last in-depth economic analysis of the Port was completed in 1992 as part of the General Design Memorandum that recommended the currently authorized project. The project design was based on a 60,000 to 80,000 deadweight tons (DWT) bulk carrier drafting between 41 and 45 feet. Benefits were claimed for phosphate rock exports to Europe and the Indian Subcontinent. Benefits were not claimed for exports to Australia or the Far East, because of draft limitations imposed by the Panama Canal. Historic tonnage from 1985-1991 (time of deepening study) ranged from 3.6 to 6.3 million tons.

Although some changes have occurred in ship traffic and commerce, the Port is handling an average of 4.0 million tons of commerce annually since deepening was completed in 1994, which ranks it in the middle of U.S. deep-draft ports. It serves as a significant import and export Port for a number of mining and manufacturing firms that are vital to the economy of North Carolina. In addition it is a strategic fast-strike military port for launching forces, equipment and munitions. The Port also has two location characteristics that provide an advantage to commerce and maintenance costs. One of the major commodities shipped from the Port is phosphate converted to fertilizers. The phosphate mining operation is only 80 miles away, which is approximately 90 miles closer than the next nearest port located at Norfolk, Virginia. The Morehead City Port is about 3 miles from the ocean, making it extremely accessible. Principal imports are sulfur products, rubber and scrap metal.

Most Recent Changes. The federal assumption of maintenance for the West Turning Basin was authorized in the Water Resources Development Act (WRDA) of 2000, subject to the Secretary of the Army determining that the non-federal improvements are economically and environmentally justified. The USACE prepared a report and submitted it to the Assistant Secretary of the Army for Civil Works ASA(CW), which recommended federal assumption of maintenance of the West Turning Basin, which is located between the West and Northwest Legs. The West Turning Basin was originally constructed and maintained by the State of North Carolina. It is maintained at the same depth (35 feet) and dimensions as constructed. By letter dated September 20, 2002, the ASA(CW) approved federal assumption of maintenance of the Morehead City Harbor, West Turning Basin.

Since the Feasibility Report was completed in 1992, PCS Phosphate, a phosphate mining and manufacturing company in Aurora, NC, has changed from exporting mined phosphate rock to exporting processed fertilizers, mostly monoammonium phosphate (MAP) and diammonium phosphate (DAP). These are value added products that are exported in deep draft vessels (usually drafting 36 to 42 feet). The exporting phosphate rock was done in similar vessels, but usually drafting from 38 to 45 feet. This change has allowed the maintenance dredging of the Harbor to be somewhat flexible due to the fact that a limited amount of shoaling within the channel dimensions does not adversely impact Port traffic. Current dredging practices at the Port reflect the draft requirements of recent ship traffic and Operations and Maintenance (O&M) funding limitations with maintenance not always being accomplished to the authorized project depth.

2.1.1 Waterborne Commerce

This commerce includes imports, exports and coastwise traffic in the Harbor. The Port has seen both growth and contraction in waterborne commerce from 1980 to 2011 (Table 2-2). Some of this is due to a fluctuation in phosphate and fertilizer movements, and other is due to the changing use of the Port for various commodities. Morehead City Harbor has seen the arrival and departure of several major commodities, such as coal (arrived and later departed), woodchips (arrived and later departed) , and steel (arrived). A breakdown of commerce by commodity is given below in Table 2-3. For the period from 2007 through 2011, a summary of vessel traffic by trips and drafts is provided in Table 2-4.

Calendar Year	Waterborne Commerce (Tons)	Calendar Year	Waterborne Commerce (Tons)
1980	3,066,000	1996	5,588,000
1981	3,890,000	1997	5,201,000
1982	3,724,000	1998	5,260,000
1983	4,233,000	1999	4,636,000
1984	4,190,000	2000	4,365,000
1985	3,626,000	2001	3,143,000
1986	5,225,000	2002	2,097,000
1987	5,584,000	2003	2,297,487
1988	6,287,000	2004	3,407,127
1989	6,159,000	2005	3,953,663
1990	5,049,000	2006	3,733,318
1991	5,237,000	2007	3,108,000
1992	4,440,000	2008	3,300,000
1993	3,999,000	2009	3,278,000
1994	4,195,000	2010	3,498,000
1995	4,620,000	2011	3,570,000

Table 2-2. Waterborne Commerce - 1980-2011

	All Traffic Types (Domestic & Foreign)														
	All Traffic Directions					Receipts					Shipments				
	CY2011	CY2010	CY2009	CY2008	CY2007	CY2011	CY2010	CY2009	CY2008	CY2007	CY2011	CY2010	CY2009	CY2008	CY2007
All Commodities	3,569,512	3,497,666	3,278,457	3,300,143	3,108,310	1,901,665	2,044,637	1,741,639	1,921,157	1,834,175	1,667,847	1,451,432	1,536,818	1,378,986	1,274,135
Total Coal,Lignite and Coal Coke	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Petroleum and Petroleum Products	2,431	37,597	13,287	78,955	90,222	2,408	37,597	13,287	78,955	90,222	23	0	0	0	0
Total Chemicals and Related Products	3,111,344	2,944,146	2,908,578	2,610,342	2,221,398	1,591,816	1,596,268	1,432,233	1,375,385	997,578	1,519,528	1,346,281	1,476,345	1,234,957	1,223,820
Subtotal Fertilizers	1,136,024	1,012,934	1,258,353	1,003,525	1,061,980	613,702	629,985	611,348	603,002	523,554	522,322	381,352	647,005	400,523	538,426
Subtotal Other Chemicals and Related Products	1,975,320	1,931,212	1,650,225	1,606,817	1,159,418	978,114	966,283	820,885	772,383	474,024	997,206	964,929	829,340	834,434	685,394
Total Crude Materials, Inedible Except Fuels	202,524	298,006	229,877	399,011	557,247	175,066	250,343	202,765	309,705	534,753	27,458	47,663	27,112	89,306	22,494
Subtotal Forest Products, Wood and Chips	139,199	139,222	65,491	155,625	179,794	139,199	137,251	65,491	151,822	176,008	0	1,971	0	3,803	3,786
Subtotal Pulp and Waste Paper	793	0	0	540	14,108	0	0	0	540	0	793	0	0	0	14,108
Subtotal Soil, Sand, Gravel, Rock and Stone	59	0	47,920	96,300	93,018	18	0	47,920	96,300	93,018	41	0	0	0	0
Subtotal Iron Ore and Scrap	28,575	54,668	74,323	128,084	21,794	2,211	8,976	47,211	42,581	17,194	26,364	45,692	27,112	85,503	4,600
Subtotal Marine Shells	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal Non-Ferrous Ores and Scrap	58	0	0	0	17,417	20	0	0	0	17,417	38	0	0	0	0
Subtotal Sulphur, Clay and Salt	21,547	0	42,143	18,462	221,981	21,347	0	42,143	18,462	221,981	200	0	0	0	0
Subtotal Other Non-Metal. Min.	12,293	65,116	0	0	9,135	12,271	65,116	0	0	9,135	22	0	0	0	0
Total Primary Manufactured Goods	121,299	140,807	80,154	162,530	156,244	65,335	130,277	48,062	107,807	129,205	55,964	10,530	32,092	54,723	27,039
Subtotal Paper Products	934	0	0	138	1,691	334	0	0	138	302	600	0	0	0	1,389
Subtotal Lime, Cement and Glass	395	0	0	0	359	102	0	0	0	359	293	0	0	0	0
Subtotal Primary Iron and Steel Products	115,859	112,837	55,295	134,123	112,773	61,235	102,307	23,203	79,400	90,123	54,624	10,530	32,092	54,723	22,650
Subtotal Primary Non-Ferrous Metal Products	3,851	13,814	11,278	9,973	14,473	3,664	13,814	11,278	9,973	11,473	187	0	0	0	3,000
Subtotal Primary Wood Products; Veneer	260	14,156	13,581	18,296	26,948	0	14,156	13,581	18,296	26,948	260	0	0	0	0
Total Food and Farm Products	25,900	0	171	32,509	43,759	25,856	0	103	32,509	43,759	44	0	68	0	0
Subtotal Oilseeds	19	0	0	0	0	19	0	0	0	0	0	0	0	0	0
Subtotal Vegetable Products	122	0	0	0	0	100	0	0	0	0	22	0	0	0	0
Subtotal Processed Grain and Animal Feed	57	0	44	0	0	55	0	0	0	0	2	0	44	0	0
Subtotal Other Agricultural Products	25,702	0	127	32,509	43,759	25,682	0	103	32,509	43,759	20	0	24	0	0
Total All Manufactured Equipment, Machinery	104,616	74,673	21,795	16,558	34,273	41,020	27,715	20,594	16,558	33,573	63,596	46,958	1,201	0	700
Total Unknown or Not Elsewhere Classified	1,398	2,437	24,595	238	5,167	164	2,437	24,595	238	5,085	1,234	0	0	0	82

Table 2-3. Commerce Based on Commodity

	All Vessel Types														
	All Traffic Directions	Receipt	Shipment		Receipt	Shipment		Receipt	Shipment		Receipt	Shipment		Receipt	Shipment
	CY2011			CY2010			CY2009			CY2008			CY2007		
All Drafts	2,402	1,197	1,205	2,505	1,255	1,250	2,215	1,107	1,108	2,789	1,400	1,389	2,074	1,039	1,035
0-5 ft.	608	75	533	657	94	563	575	145	430	1,086	431	655	529	162	367
6-9 ft.	1,247	686	561	1,283	715	568	1,225	649	576	1,305	681	624	1,143	592	551
10-12 ft.	327	324	3	318	315	3	217	214	3	173	169	4	168	166	2
13-14 ft.	1	1	0	25	24	1	7	6	1	12	8	4	2	2	0
15-17 ft.	7	5	2	10	3	7	7	5	2	8	6	2	13	8	5
18-20 ft.	26	14	12	30	14	16	39	12	27	34	16	18	32	10	22
21-23 ft.	31	21	10	21	14	7	27	16	11	26	12	14	40	21	19
24-26 ft.	36	18	18	47	20	27	31	18	13	28	19	9	30	15	15
27-29 ft.	33	15	18	31	20	11	34	19	15	52	22	30	42	22	20
30-32 ft.	35	21	14	38	23	15	25	20	5	29	22	7	32	23	9
33-35 ft.	19	12	7	20	7	13	14	2	12	21	10	11	30	16	14
36-38 ft.	23	4	19	20	6	14	11	1	10	12	4	8	8	1	7
39-40 ft.	9	1	8	5	0	5	1	0	1	2	0	2	3	0	3
41 ft.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
42 ft.	0	0	0	0	0	0	1	0	1	1	0	1	1	1	0
43 ft.	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
44 ft.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45 ft.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2-4. Vessel Traffic by Trips and Drafts (data from the Waterborne Commerce Statistics Center)

North Carolina State Port Terminal. The NCSPA operates the State Terminal at Morehead City. This terminal has several attractive characteristics to serve both commercial and military cargo. It is only 3 miles from the open sea; its channel is 3 feet deeper than the larger port at Wilmington; and Morehead City's proximity to the ocean and nearby military facilities has generated a strong military presence. Cargo handling activities at Morehead City Harbor support nearly 4,000 jobs statewide and generate $26 million annually in local and state tax revenues.

Morehead City handles mostly bulk cargo with some break-bulk and general cargo. Bulk Cargo is loose cargo (dry or liquid) that is loaded (shoveled, scooped, forked, mechanically conveyed or pumped) in volume directly into a ship's hold; e.g., grain, coal and oil. Break-bulk cargo is non-containerized general cargo stored in boxes, bales, pallets or other units to be loaded onto or discharged from ships or other forms of transportation. Examples include iron, steel, machinery, linerboard and wood pulp. The Port is second only to New Orleans, Louisiana, in rubber imports. Other key imports are sulfur products, ore and stone, scrap metal, and aggregate. The port exports primarily one thing — phosphate fertilizers. In 2009, the NCSPA terminal at Morehead City processed more than 3.3 million tons of cargo, with much of that moving to and from India, Venezuela, Brazil, China, and Indonesia. Table 2-6 provides detailed information on NCSPA commodities being imported and exported from 2002 to 2011 and Table 2-7 provides information on the top ten trading partners at Morehead City. The Pacific Rim nations send their cargo to East Coast ports for two reasons, says Karen Fox, director of communications at NCSPA. First, booming international trade is congesting West Coast ports. Second, Fox says, "It's still more cost effective to take your ship through the Panama Canal and by water to East Coast ports than it is to go to a west coast port and rail the cargo across the country."

The Morehead City Harbor serves as a gateway to world markets for North Carolina business and industry. Products handled include phosphate fertilizers exported by PCS Phosphate of Aurora, lumber for construction and retail sale, natural rubber used for tire manufacturing at the Bridgestone Firestone plant in Wilson and the Goodyear plant in Fayetteville, scrap metal for the Nucor Steel plant in Hertford County, colemanite used in fiberglass, and military equipment to support our national defense efforts.

Morehead City has facilities to serve the needs of deep draft vessels. Berths, cargo handling equipment and warehouse space are available at the NCSPA docks. As a leading exporter of phosphate, the Terminal features a dry-bulk facility with a 225,000-ton capacity warehouse and open dry-bulk storage. The Port opened a new 177,000 square foot storage warehouse in 2007 to enhance its facilities. It is designed to house high value commodities such as paper, steel, and lumber. This warehouse features 29' ceilings and easy access to ocean berths.

Commercial tug power consists of 4 tugs ranging in size from 350 to 1400 horsepower. The nearest facilities for major repairs to military and commercial vessels are at Norfolk and Newport News, VA.

Commerce for the NCSPA docks over the past 10 years is shown below in Table 2-5 and Figure 2-1. The State of North Carolina is on a data year of July 1 to June 30, so data will not match up with information from the Navigation Data Center. The data below does not include commerce at other terminals in the Harbor, or military use. The Waterborne Commerce Data includes all commerce in the Harbor, except military. Military commerce on military owned or chartered ships is not required to report to Waterborne Commerce.

10-Year Vessel Trend			Ten Year Tonnage Trend			
Fiscal Year	**Ships**	**Barges**	**Year**	**Breakbulk**	**Bulk**	**Total**
2011	128	549	2011	212,182	1,798,379	2,010,561
2010	122	465	2010	198,965	1,569,747	1,768,712
2009	118	415	2009	167,454	1,725,432	1,892,886
2008	124	414	2008	231,072	1,652,863	1,883,935
2007	153	436	2007	276,128	1,862,213	2,138,441
2006	164	411	2006	375,998	1,922,386	2,298,384
2005	156	348	2005	315,440	2,115,309	2,430,749
2004	168	250	2004	214,948	2,000,643	2,215,591
2003	153	191	2003	243,574	1,296,618	1,540,692
2002	132	209	2002	213,583	1,294,005	1,507,588

Table 2-5. NCSPA 10-Year Vessel and Tonnage

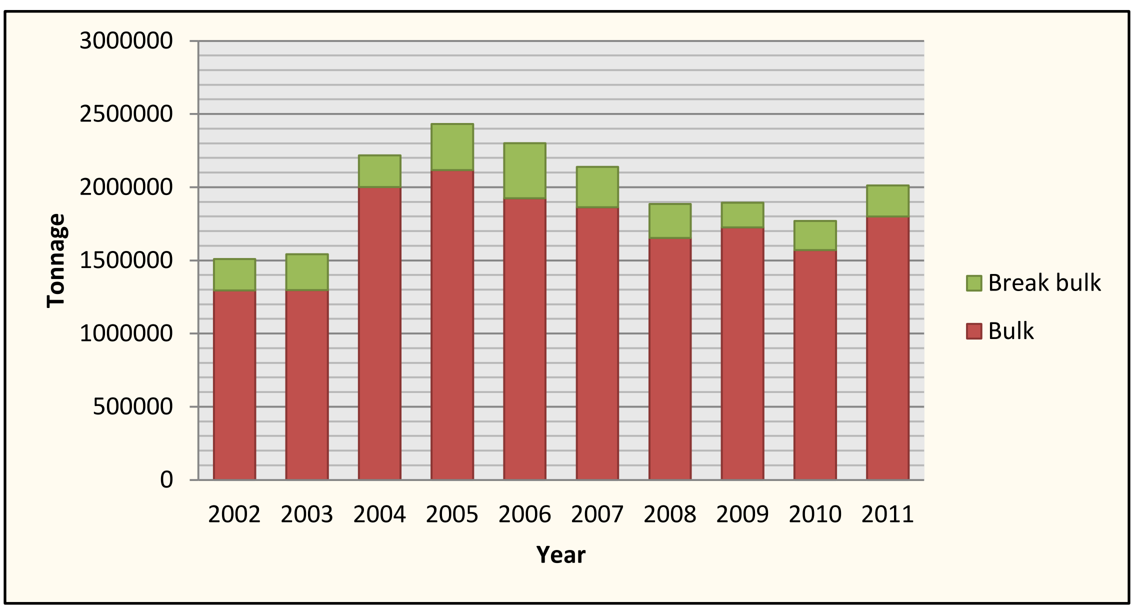


Figure 2-1. NCSPA 10-Year Vessel and Tonnage

Year	Commodity	Import	Commodity	Export
2011	Sulfur Products	165,597	Phosphate	1,397,717
	Rubber	132,914	Metal Products	19,119
	Scrap Metal	99,851	Scrap Metal	8,969
	Potash	56,622	Military	4,165
	Metal Products	46,973	Urea	1,504
2010	Sulfur Products	298,706	Phosphate	1,090,649
	Rubber	119,358	Gen. Merch./Misc	47,091
	Scrap Metal	83,525	Military	2,748
	Metal Products	57,811		
	Ore, Micah, Schist	26,268		
2009	Sulfur Products	326,147	Phosphate	1,044,249
	Rubber	117,505	Military	2,981
	Gen Merch/Misc	108,617		
	Scrap Metal	76,709		
	Ore, Mica, Schist	56,107		
2008	Sulfur Products	286,768	Phosphate	1,044,249
	Rubber	155,163	Military	1,510
	Scrap Metal	126,901		
	Aggregate	94,532		
	Ore, Mica, Schist	59,635		
2007	Sulfur Products	283,018	Phosphate	1,211,017
	Rubber	157,849	Forest Products	3,787
	Ore, Mica, Schist	114,639	Military	3,500
	Scrap Metal	111,001	Gen. Merch./Misc	1,317
	Aggregate	91,067		
2006	Scrap Metal	363,125	Phosphate	1,041,117
	Sulfur Products	295,439	Military	6,199
	Rubber	251,874	Gen. Merch./Misc	1,271
	Ore, Mica, Schist	136,489		
	Forest Products	78,810		
2005	Sulfur Products	457,539	Phosphate	1,121,970
	Scrap Metal	285,550	Aggregate	8,641
	Rubber	206,614	Metal Products	8,337
	Asphalt	115,537	Military	8,125
	Ore, Mica, Schist	110,051	Gen. Merch./Misc	2,995
2004				
	Scrap Metal	303,540	Military	10,557
	Rubber	175,765	Metal Products	4,750
	Asphalt	152,756	Gen. Merch./Misc	2,006
	Ore, Mica, Schist	90,545		
2003	Sulfur Products	299,780	Phosphate	666,640
	Rubber	180,201	Metal Products	27,095
	Ore, Mica, Schist	114,960	Military	14,590
	Asphalt	93,506	Gen. Merch./Misc	4,263
	Scrap Metal	85,154	Food	2,198
2002	Sulfur Products	212,004	Phosphate	444,660
	Scrap Metal	179,307	Woodchips	163,815
	Rubber	149,024	Military	13,659
	Ore, Mica, Schist	133,277	Gen. Merch./Misc	2,656

Table 2-6. NCSPA Top Five Commodities by Year- 2002-2011

Import		Export		Total Trade	
Indonesia	106,732	India	1,063,415	India	1,063,572
Mexico	92,525	Brazil	256,695	Brazil	308,906
Venezuela	59,216	Argentina	28,611	Indonesia	106,732
Brazil	52,211	Colombia	26,935	Mexico	92,525
Turkey	39,325	Peru	16,388	Venezuela	63,625
Israel	35,477	Honduras	7968	Turkey	39,325
Poland	34,289	Venezuela	4409	Israel	35,477
Russia	33,270	Puerto Rico	4210	Poland	34,289
Thailand	27,316	Chile	3453	Russia	33,270
Canada	26,010	Dom. Republic	2022	Argentina	28,611

Table 2-7. Top Ten Trading Partners, Morehead City, 2011

Military Use. Next to California and Texas, North Carolina has the third largest active duty military personnel in the U.S. with over 100,000 soldiers and additional 46,000 civilian, reserve and National Guard. North Carolina is home to: Marine Corps Base Camp Lejeune; Marine Corps Air Station New River; Marine Corps Air Station Cherry Point; Fort Bragg, United States Army Installation; Pope Army Airfield; Military Ocean Terminal Sunny Point; Seymour Johnson Air Force Base; Air Station Elizabeth City, United States Coast Guard. Morehead City Harbor is the main port of embarkation and debarkation for the Second Division of the U.S. Marine Corps at Camp Lejeune.

The U.S. Navy-owned facilities in the Morehead City/Beaufort area include three Landing Ship, Tank (LST) ramps and a large paved staging area at the southern tip of Radio Island. The Navy also uses portions of the NCSPA facility, mainly in the West and Northwest legs. The West leg also includes an LST ramp. Commercial traffic includes deep draft vessels (general, break-bulk and bulk cargo), AIWW traffic and the commercial fishing fleets. Deep draft vessels berth at the State Port Terminal, Morehead City and a liquid bulk terminal on Radio Island. These vessels also may transport some military cargo for the nearby military bases and facilities.

Navy use of the Harbor centers on the embarking and debarking of Marine Corps elements based at Camp Lejeune and Cherry Point. The Navy-owned LST ramps at Radio Island are for this purpose. Additionally, by prior arrangement through the Naval Port Control Office with the management of the State Port Terminal, visiting Navy ships may also use deep water berths or the state-owned LST ramps at the terminal. The latter are rarely used due to awkward approaches for vehicles. Eight deep water berths are used for loading Navy amphibious ships. Vessels operated by or chartered to the Military Sealift Command berth at the Aviation Fuel Terminal on Radio Island. Both the Navy and the Military Sealift Command ships use the Port of Morehead City for their activities.

Value of Commodities. In the most recent data available from 2011, Morehead City Harbor (including Beaufort) reported commodities handled of 575 million dollars worth of exports and 497 million dollars worth of imports. These imports, along with coastwise shipments and receipts are required to pay into the Harbor Maintenance Trust Fund

(HMTF), which is described below. Coastwise shipments are ocean commerce that goes from one US port to another.

<u>Harbor Maintenance Trust Fund</u>. The Harbor Maintenance Trust Fund (HMTF) and its Harbor Maintenance Tax were authorized in the Water Resources Development Act of 1986. The purpose of the Tax, a 0.125 % ad valorem tax levied on cargo imported or domestically moved through federally maintained channels and harbors, is to pay for USACE operations and maintenance of these ports and harbors. The Tax is collected by the Bureau of Customs and Border Protection and directed to the Trust Fund. However, the monies are not immediately eligible for dredging activities. Those monies can only be spent if the funding is actually appropriated by Congress. In Fiscal Year 2009 the tax revenues collected from all U. S. Ports amounted to $1.6 billion, and the funds appropriated to the USACE for maintenance dredging activities were $766 million.

<u>Channel Portfolio Tool.</u> The Channel Portfolio Tool (CPT), previously known as the Channel Prioritization Tool, is a decision-support software package designed by ERDC to assist Corps Operations personnel with Operations and Maintenance (O&M) dredging budget development. CPT uses the Corps-use-only, dock-level tonnage database provided by IWR's Waterborne Commerce Statistics Center (WCSC) to provide Operations personnel with ready access to information concerning utilization of channel depths by commercial shipping. The underlying commerce data are the same figures that feed existing tools such as OMBIL, but CPT allows for these data to be more fully analyzed and viewed in more detail, as opposed to a single tonnage value for an entire navigation project. CPT is web-accessible and provides various levels of detail, from sub-reach level resolution all the way to Division-level consolidated statements of cargo. A commodity flow feature allows the user to see all other US ports, channels, and waterways used by cargo transiting a given reach. CPT has been developed in direct response to calls from USACE-HQ for more consistent, transparent, and objective prioritization of O&M dredging budget items, and preliminary briefings to OMB examiners have been received favorably. ERDC is presently working on suggested updates to the Navigation Budget EC to provide guidance for the use of CPT in budget development starting in FY13. Wilmington District’s use of CPT represents early adoption of an approach expected to be employed throughout USACE. Representatives from the Deep Draft Navigation PCX have been briefed on CPT on at least one occasion during a visit to ERDC. However, since CPT has been conceived as a tool primarily for assisting Operations personnel with year-to-year O&M budgeting, Deep Draft Navigation Planning Center of Expertise has not yet been consulted extensively. Though still in the developmental stages, it is anticipated that CPT may ultimately have applications beyond O&M budgeting, so ERDC developers welcome collaboration with other potential Corps user groups. The CPT is not a planning model; it is a tool for quickly accessing the existing Waterborne Commerce data to inform O&M budgeting.

Therefore, the requirement for model certification would not apply. ERDC is still validating it against the official, published WCSC figures, hence labeling it as "developmental". The CPT is not used in any sort of "planning" capacity within the

DMMP, but is used only to present existing data on the port of Morehead City to indicate its importance to the Nation.

This tool is still preliminary, but information on Morehead City Harbor is now being processed. The following table shows the average flow of tons and value at various drafts for 2003-2010. For this time series, the data showed Morehead City Harbor handle, on average, about 2.9 million tons of cargo having a value of almost $920 million.

	Draft (feet)	Tonnage (x1k)	Value (x1k)
Commodity traffic	44	7.5	$944
	43	8.4	$2,503
	42	41.6	$14,324
	41	8.6	$2,933
	40	52.6	$22,785
	39	25.5	$4,753
	38	69.4	$18,590
	37	67.2	$19,492
	36	124.7	$60,354
	35	149.7	$55,370
	34	119.8	$50,003
	33	58	$95,126
All Commodity traffic drafting 32 feet or less		2,248	$572,280
Total Traffic for Morehead City Harbor		2,981	$919,457

Table 2-8. Tonnage and Value of Commodities by Vessel Draft

Table 2-8 shows that there are about 119 tons worth about $43,500,000 in the last 5 feet of draft (40 to 44 feet). This tool will allow Morehead City Harbor to be compared to other similar sized harbors, to see the tons and value being handled at various depths. We do not know yet how the Morehead City Harbor will stack up against these other ports, or how the designation of a strategic military harbor will impact the budget process. This tool is another indicator for developing the annual operation and maintenance budget for deep-draft harbors.

Panama Canal Expansion. The existing Panama Canal dimensions can accommodate a maximum vessel draft of 39.5 feet (tropical fresh water), maximum vessel beam of 106 feet, and maximum vessel length of 965 feet. Presently, vessels calling at Morehead City Harbor are limited to about 38.5 feet salt water draft if their itinerary includes going through the existing Panama Canal. The expanded canal, which is currently scheduled for completion in 2014, is designed to accommodate a maximum vessel draft of 50 feet (tropical fresh water), maximum vessel beam of 160 feet, and maximum vessel length of 1,200 feet. Possible effects of the Panama Canal Expansion may be a shift of vessels arriving from Asia or carrying exports to Asia to larger or deeper draft vessels. As this restraint at the Panama Canal is lifted, larger vessels may be able to use the additional draft at Morehead City. In other words trade with Morehead City would no longer be draft limited by the Canal once the planned expansion occurs. This would open markets in the Far East, Southeast Asia, Australia, and the West Coast of South America to deeper draft trade with Morehead City.

As currently maintained, the Morehead City Harbor could accommodate vessels coming through the expanded canal to a depth of about 44 feet using the advantage of high tide.

<u>Future Port Facilities Expansion</u>. The North Carolina State Ports Authority owns about 250 acres on Radio Island, of which 150 acres is actually suitable for additional port development. An Environmental Impact Statement (EIS) on the property, prepared in 2001, calls for construction of a marine terminal with 2,000 feet of wharf, warehouse space, and paved, open storage. The EIS also specifies dredging to bring the 45-foot-deep Morehead City navigational channel to the face of Radio Island. These proposed facilities can be expected to increase shipping and commerce in the Harbor, if and when the development is undertaken.

2.1.2 Economic Viability

Morehead City Harbor serves as a significant import and export harbor for a number of mining and manufacturing firms that are vital to the economy of North Carolina. In addition, given Morehead City Harbor's short entrance channel and its proximity to important military bases, it is also a strategic, fast-strike military port capable of launching forces, equipment and munitions. Military bases are important to the economic and employment base for North Carolina and the two deep draft ports of Wilmington and Morehead City are strategic ports for the U.S. military. Continuing development of the Global TransPark (GTP) in Kinston will increase commerce coming through the port of Morehead City. The State has just contracted to build a rail spur to a Spirit Aero Systems facility in the GTP to allow rail connection to the Morehead City Harbor. Airplane sections built in Kinston will be exported to Europe through the Port. This rail spur is expected to serve additional industries as the park continues to develop. As the recession eases and bulk shipping begins to recover, additional commerce can be expected using the Morehead City Harbor.

One of the requirements of a DMMP is to demonstrate that continued maintenance is economically warranted based on high priority (non-recreation) benefits. The above information shows the economic importance of Morehead City Harbor to the Nation, the Region, the State and the Military. Morehead City Harbor delivers high priority National Economic Development (NED) benefits, is a National Strategic Port and, therefore, warrants at least 20 more years of continued O&M dredging.

2.1.3 Existing Physical Conditions

Morehead City Harbor contains one of the most accessible deep draft ports on the east coast of the United States. The Port Terminal is located only three miles from the open sea and the channel is easily navigable.

As a leading exporter of phosphate, the Terminal features a dry-bulk facility with a 225,000-ton capacity warehouse and open dry-bulk storage. Access to Interstates 95 and 40 is available via U.S. Highways 70 and 17 in addition to daily train service from Norfolk Southern.

The Port has two 115-ton capacity gantry cranes, a container crane, 36 lift trucks, a certified truck scale, and a constant motion rail scale. In 2007, the Port opened a new 177,000 square foot storage warehouse, which is available to house high value commodities such as paper, steel, and lumber. The State Ports Authority also owns approximately 185 acres of undeveloped acreage adjacent to the Morehead City navigation channel on Radio Island.

Full-service port support is available on site, including stevedores, agents, line handlers, towing companies, chandlers, brokers, bankers, and marine repair facilities. All U.S. Customs services are provided at the Port of Morehead City.

The Port is approved as Foreign Trade Zone 67. A Foreign Trade Zone allows for storage, manipulation, exhibition, and limited manufacturing operation for cargo. The Foreign Trade Zone can lower, defer or avoid import duties.

Morehead City Harbor is located within the confluence of the Newport River and Bogue Sound. The average tidal range from mean high water to mean low water in Morehead City Harbor is about 3.1 feet.

Salinity concentrations in the navigation channel through Beaufort Inlet are near sea strength (Salinity greater than 34 parts per thousand) and range from 29.0 parts per thousand (ppt) to 34.5 ppt depending on the sample location, tidal cycle and freshwater discharge (Churchill et al. 1999).

2.2 Planning Requirement

The DMMP alternatives were developed in accordance with federal policy guidance included in the Planning Guidance Notebook (Appendix E of ER 1105-2-100) regarding the planning process and methods of analysis. The USACE planning process is grounded in the economic and environmental Principles and Guidelines (P&G). The P&G were set forth to provide for the formulation of reasonable plans responsive to National, State and local concerns. The USACE planning process places specific emphasis on sound judgment and planners and other team members shall be guided by common sense in applying the USACE planning process, which consists of the following six steps:

Step 1 - Identifying problems and opportunities
Step 2 - Inventorying and forecasting conditions
Step 3 - Formulating alternative plans
Step 4 - Evaluating alternative plans
Step 5 - Comparing alternative plans
Step 6 - Selecting a plan

2.3 Problems and Opportunities

Identification of problems and opportunities is the first step of the USACE planning process defined by the Planning Guidance Notebook (ER 1105-2-100). This step is very important to the overall process and is conducted in each phase of DMMP studies. At the beginning of this final DMMP phase, the PDT discussed the issues and concerns involving all aspects of project O&M and identified dredging and disposal needs for each range of the Morehead City Harbor project. Environmental concerns and issues were further identified, defined, and discussed during the initial planning efforts for the DMMP study. Federal and state resource agency concerns, views, and input were received during the National Environmental Policy Act (NEPA) scoping process and during informal discussions at monthly Project Delivery Team (PDT) meetings. The principal problems and potential opportunities are briefly addressed below. More specific discussion of problems and opportunities is included in Section 3 (Alternatives) of this document.

<u>Problems</u>.

- The USACE annually removes over one million cubic yards of material from the Harbor and currently there is no formal plan in place that ensures that sufficient disposal capacity is available for at least the next 20 years. Current maintenance disposal practices, without modification, will result in the need for "new" or expanded disposal sites or modified disposal options (beneficial uses), by 2029.

- As discussed in detail in Section 3 (Alternatives), data suggests that there has been substantial deflation of the ebb tide delta at Beaufort Inlet.

- Beach areas provide essentially unlimited disposal capacity, but the use of beaches for disposal can be constrained by sediment quality, environmental windows, and costs.

- Shoaling and urgent dredging needs may occur at times when dredging and disposal options, such as beach disposal, would conflict with acceptable environmental windows.

Opportunities:

- Potential beneficial uses for environmental purposes including fish and wildlife habitat creation, ecosystem restoration and enhancement and/or coastal storm damage reduction

- Placement of suitable maintenance dredged material in the ebb tide delta would retain sediment in the littoral system and reduce future deflation of the ebb tide delta.

- Use of upland disposal sites for the creation and preservation of habitats for various species of plants and animals

- Implement a regional sediment management (RSM) approach for dredged sediments where dredged material is disposed of based on beneficial and economic considerations.

Environmental stewardship is a continual goal of the USACE. The USACE is continually challenged to determine how to conduct work more cost efficiently without adversely impacting the environment. Therefore, this Dredged Material Management Plan is being developed as the most flexible, engineeringly sound, economically justified plan that can be reasonably implemented, which is consistent with environmental laws, regulations, and goals. Pursuant to 33 CFR 335.4, the USACE undertakes operations and maintenance activities where appropriate and environmentally acceptable. All practicable and reasonable measures are fully considered on an equal basis. This includes the discharge of dredged material into waters of the U.S. or ocean waters in the least costly manner, at the least costly and most practicable location, and consistent with engineering and environmental requirements.

2.4 Key Assumptions

General. The key assumptions made for this study are that the base physical and economic conditions will continue throughout the 20-year period of analysis, beginning in 2015 and going through 2034.

The DMMP assumes that the Morehead City Harbor navigation project will be maintained to the fully authorized project dimensions. It is assumed that the North Carolina State Port in Morehead City will remain viable and that maintenance of the Harbor will continue at least through the next 20 years It is also assumed that there will continue to be a demand for recreational and commercial boating and fishing throughout the study area.

Additionally, physical surveys used throughout the report are assumed to have been through sufficient quality control procedures when acquired to eliminate systematic survey errors. As such, any errors associated with present and past surveys are considered random. These random errors are considered equally distributed and are neglected from all calculations. One exception to this is the June 2005 ebb tide delta survey which was found to have an error associated with the data file. Due to the limited quantity of ebb tide delta surveys available for use in this report this survey was adjusted and used in the delta deflation calculations. A detailed description of the corrective measures applied to this survey is included in Section 3.2.4.1 of this report.

Sediment analyses. In an attempt to retain more maintenance dredged material in the "system" and to prolong the longevity of Brandt Island, an additional analysis of sediment samples was conducted in 2011 to further discern the various sediment types within the Harbor. As shown in Figure 2-2, the Harbor ranges have now been divided into three categories: (1) fine-grained material less than 80% sand; (2) material between 80% and 90% sand and; (3) material greater than 90% sand. The Northwest Leg, a portion of the West Leg (referred as West Leg 1) and the East Leg contain fine-grained sediments less than 80% sand. The eastern portion of the West Leg (West Leg 2) and North Range C contain sediments that are between 80 and 90% sand. From South Range C out to station 117+00 of Range A sediments are greater than or equal to 90% sand. The area in Range A between stations 117+00 and 100+00 contains sediments that are between 80 and 90% sand and the very outer end of Range A beyond station 117+00 contains fine-grained sediments less than 80% sand. The base plan for the DMMP is based on these sediment characteristics.

Inner/Outer Harbor Dredged Material Separation Based on Percent Sand

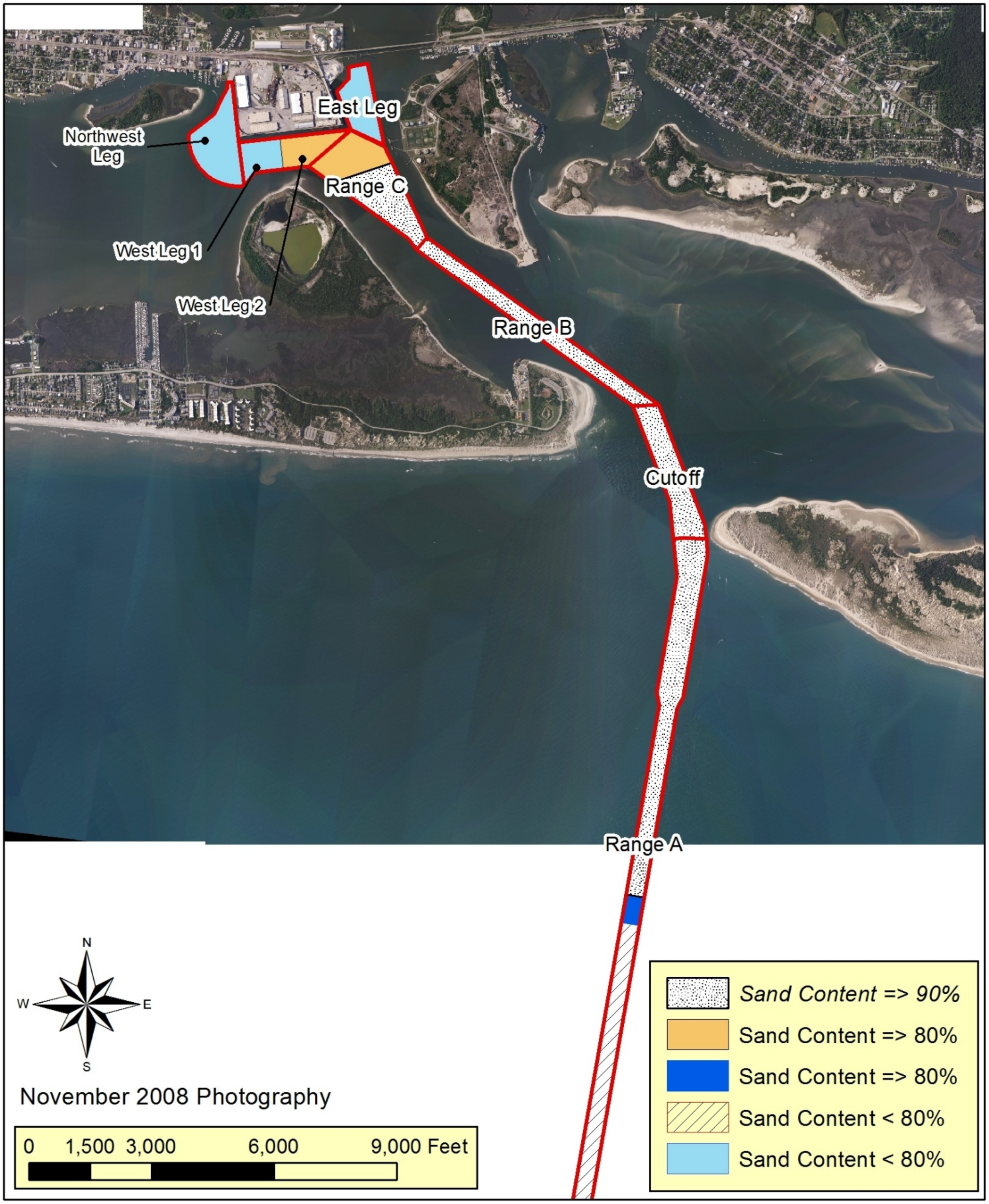


Figure 2-2. Inner/Outer Harbor Dredged Material Separation Based on % Sand

Shoaling Rates. One of the most important and governing technical assumptions made during development of the DMMP is the use of annual shoaling rates as the basis for dredged material volumes, costs and required disposal capacity. Appendix C contains a detailed explanation of how the shoaling rates were calculated. As explained in Appendix C, the purpose of the shoaling analysis is to determine the average amount of material that is shoaling into the navigation channel at Morehead City Harbor on an annual basis. Shoaling rate estimates provide the most conservative approach in determining future disposal capacity requirements because they include all material coming into the system. In general, the shoaling rate numbers represent the greatest material volumes that would ever be expected to be dredged from the Morehead City Harbor Navigation Channel (assuming no funding limitations). In fact, all DMMP analyses, including sediment volumes and costs are based on maintaining the Morehead City Harbor channel to its fully authorized dimensions.

Comparison of the past dredging records to the calculated shoaling rates show that the amount of material typically dredged is less than the computed annual shoaling rates for the channel. Past dredging quantities are constrained by several factors which result in these volumes being less than the computed average annual shoaling rate. Some of the factors that impact the past dredging quantities and explain the separation between the two numbers include: 1) During the actual dredging operation the contractor assumes responsibility for the occupied channel and any shoaling that occurs during the dredging operation. Depending on the channel conditions, a contractor may occupy a channel for up to 10 weeks while dredging the channel to a contract template. A significant percentage of the annual shoaling is essentially removed at no direct cost during this contractor occupied period. 2) As discussed in Appendix C, the shoaling rate is an annual quantity developed through averaging changes within the channel over time. Throughout the channel, past dredging practices have been limited by funding and as a result, the areas that restricted the channel the greatest were dredged. The quantities removed during these events do not represent removal of all shoaling within the channel or even all shoaling that may impede shipping. They are simply the quantity removed with the funding available for that dredging event. This funding-limited dredging approach results in the actual dredged quantity being lower than the shoaled quantity for a given reach and partially explains the difference between the computed shoaling rate and past dredge quantities. 3) The third factor which may explain why computed shoaling rates exceed past dredging quantities is that the shoaling rates were developed by comparing surveys between dredging events and not by comparing surveys to a project template. Past dredging quantities would not include material removed below a project template as this material is defined in the contract as "non-pay". However, this material is captured within the annual shoaling rate calculation and this will contribute to the differences between the shoaling rates and past dredging quantities.

To effectively evaluate both future required disposal capacity and project costs, two sets of shoaling rates are required. The full annual shoaling rate is used within this DMMP to ensure adequate future disposal capacity for at least the next 20 years. To more accurately calculate project costs over the life of the DMMP, a reduced annual shoaling rate was developed. The reduced rate was computed by removing the quantity of material from the annual rate that is typically dredged at no direct cost to the government while the contractor occupies the channel during dredging. Dredging records were analyzed from 1997 through 2008 and an average contract dredging duration was calculated for each reach within the navigation channel. The conversion of these durations into a percentage of a year for each reach enabled the shoaling rate to be reduced by the amount that is typically dredged at no direct cost (Table 2-9). By reducing the average shoaling rate by these amounts, a representative shoaling rate that more closely matches the quantities used to develop past dredging pumping costs is produced. The “non-pay” quantities that result from a contractor dredging allowable overdepth as discussed above were considered negligible and were not deducted from the original shoaling rate in developing the reduced rate.

The descriptions of the DMMP alternatives (Section 3, Formulation and Evaluation of Alternative Plans) include additional technical assumptions regarding the size, configuration, material requirements, in-place volume, and other parameters used to estimate quantities for development of costs and for determining specific disposal site capacities.

Range	Shoaling Rate (C.Y./Year)	Average Dredge Contract Duration (1997-2008)	Reduction Factor Based on Average Contract Dredged Duration	Representative Shoaling Rate (C.Y./Year) Used for Economic Evaluation
Range A Suitable	630,500	65.0	82.2%	518,000
Range A Unsuitable	118,500	12.2	96.7%	114,500
Range B	171,000	39.5	89.2%	152,500
Cutoff	324,500	70.0	80.8%	262,000
Range C Suitable	80,500	48.5	86.7%	70,000
Range C & East Leg Unsuitable	86,000	48.5	86.7%	74,500
West Leg	28,000	14.0	96.2%	27,000
Northwest Leg	80,000	45.5	87.5%	70,000

Table 2-9. Dredged Material Quantities Used in the Development of the DMMP

Sea Level Rise. In an effort to conform to Engineering Circular 1165-2-212 (USACE 2011) an analysis of the project impacts relative to increased sea levels over the life of the Morehead City Harbor DMMP was conducted. This circular requires that “Potential relative sea-level change must be considered in every USACE coastal activity as far inland as the extent of estimated tidal influence”. The analysis included development of relative sea level rise projection curves, identification of potential impact areas and associated risks, and establishing adaptive measures to adjust to future sea level rise.

Using the methods published in EC 1165-2-212, the relative sea level rise curves were developed for “low,” “intermediate,” and “high” rates of future sea-level change. The “low” sea level change curve is simply an extrapolation of the observed historic sea-level trend obtained at the Beaufort tide gauge station. The “intermediate” curve represents sea level rise using the National Research Council (NRC) Curve I and the “high” curve represents NRC Curve III. In addition to these required curves, an additional intermediate curve was developed between NRC Curves I and III which represented NRC Curve II.

The Beaufort tide gauge used in this analysis is a long term data gauge with a 53 year data record used to develop the mean sea level trend seen in Figure 2-3. In addition, the Beaufort gauge is the datum used during dredging of the Morehead City Harbor Navigation channel to establish mean low water depths. As shown in Figure 2-4, the gauge is located within approximately one mile of the navigation channel and should provide an ideal representation of historic sea level rise affecting the channel.

Figures 2-5 and 2-6 are the sea level rise curves developed in response to EC 1165-2-212. The curves cover the 20 year duration of the DMMP, which is scheduled to begin in fiscal year 2015. Figure 2-5 contains the sea level rise curves based exclusively on the currently estimated value for global sea level rise which is 1.7 mm/year. Presenting these curves on the same graph shows the extreme variation between the historic rates extrapolated over twenty years to the most aggressive sea level rise prediction seen in NRC Curve III. The historic rate extrapolation produced a sea level rise increase of 0.034 meters (1.34 inches) by the year 2035 while using NRC Curve III predicts a sea level rise over the twenty year project of approximately 0.183 meters (7.20 inches), or a 0.149 meter (5.87 inches) difference.

The curves shown in Figure 2-6 include the global eustatic sea level rise plus increases due to isostatic changes. The trend computed from measured historic data at the Beaufort tidal gauge represent a combination of the eustatic and isostatic changes impacting Beaufort Inlet and as such are a more appropriate tool in predicting local sea level changes. The trend established at the Beaufort gauge shows sea level change on average is 2.57 mm/year over the previous 53 years of recorded data at Beaufort Inlet. This is approximately 0.87 mm/year larger than the 1.7 mm/year value used to estimate global sea level rise. Projecting the observed sea level rise rate over the 20 year period of analysis for the DMMP shows an increase of 0.051 meters (2.01 inches) when looking at the historic curve extrapolation. The increase found using the NRC curve III projection is approximately 0.201 meters (7.91 inches). The variation of sea level change values between the historic projection and the use of NRC Curve III remains relatively unchanged at 0.15 meters (5.91 inches), the same variation predicted when using the eustatic values only.

In examining the applications and potential risks of sea level rise as it applies to this DMMP it was found that the project has limited exposure to the effects of sea level rise and no associated risks. The project consists of dredging the Morehead City Harbor Navigation channel with disposal of dredged material in the most suitable locations to minimize impacts of the dredging operations on the littoral system. The areas of the project exposed to the effects of sea level rise include: 1) Increased water levels within the navigation channel; 2) Increased water levels within the nearshore placement area and Ocean Dredged Material Disposal Site (ODMDS); 3) Increased water levels along the adjacent beach disposal areas; and 4) Increased water levels along the berthing areas of the Port of Morehead City.

The exposed areas of the DMMP discussed above would have no negative impact related to sea level rise over the life of the project for several reasons. Dredging quantities within the navigation channel are determined by maintaining minimum authorized depths which vary throughout the authorized channel. Water level increases would not impact dredging quantities due to the fact that the same depths as related to mean low water would be maintained. Even though water level heights would increase over the life of the project, dredging depths would remain constant below the new mean low water surface elevations. Conversely, when considering the nearshore placement and ODMDS increased water levels would provide additional storage capability, however minor, within these areas which would be viewed as a minor benefit of sea level rise. Both the east and west nearshore placement areas extend to approximately the -17' NAVD contour which would easily accommodate placement of material more landward as sea levels increase. Modification of future placements more landward as the project progresses may be necessary to continue to make every effort to place material within the active littoral zone. Along the adjacent beaches of Bogue Banks and Shackleford Banks, which have been established as potential disposal areas for beach quality dredged material, water level increases would slightly impact the project. The design of the dredged material beach disposal is partially based on the current height of the berm within the potential beach disposal areas. The current berm height within this area is approximately 6' NAVD. As water levels increase over the life of the project, the berm heights within this area will naturally adjust higher to a stable profile. Future disposals will need to be adjusted to the new berm heights to ensure smooth transitions between the existing beach and future beach disposals. Adjustments would not impact future costs due to the fact that surveys are obtained prior to the design of each beach disposal template using current design practices. These surveys provide all necessary information needed to accommodate the natural berm height adjustments relative to future sea level rise. The fourth potential impact of sea level rise noted was the increased water levels along the berthing areas of the Port of Morehead City. The most aggressive sea level rise projection obtained from NRC Curve III indicates an increase of 0.201 meters or nearly 8 inches at the end of the 20 year DMMP. No adjustments to the DMMP were made to account for the change of water depths at the berthing areas because one of the assumptions is that the Port of Morehead City will remain viable throughout the DMMP lifecycle. It is assumed that necessary adjustments to the Port to accommodate sea level rise will be made by the NCSPA as part of their maintenance and expansion efforts.

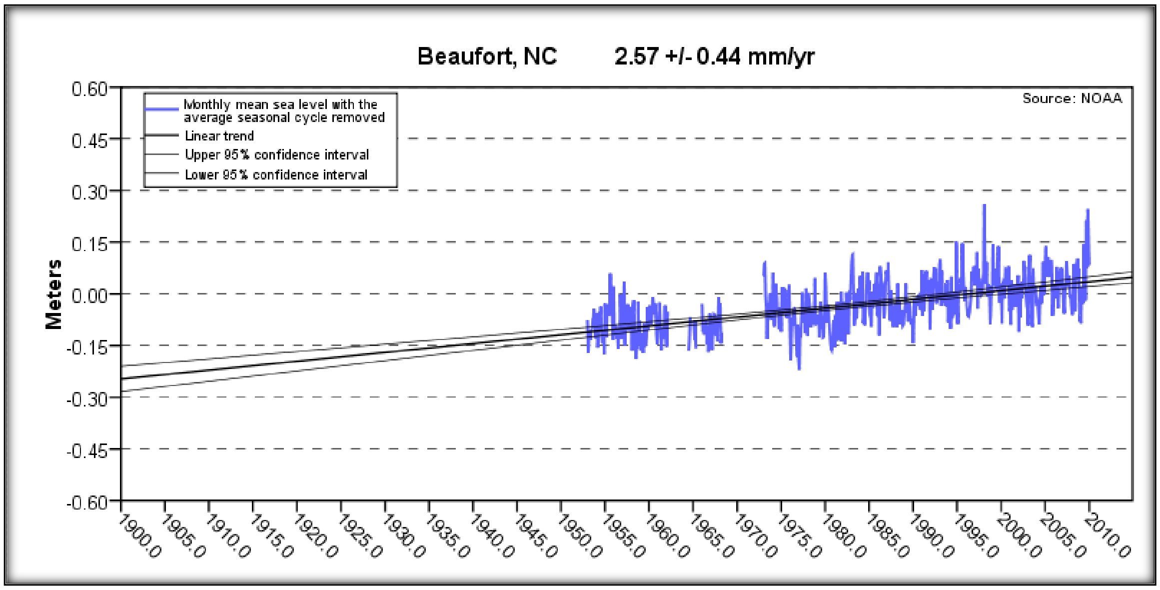


Figure 2-3. Beaufort Tidal Gauge Historic Sea Level Trend

Figure 2-4. Beaufort Tidal Gauge Location

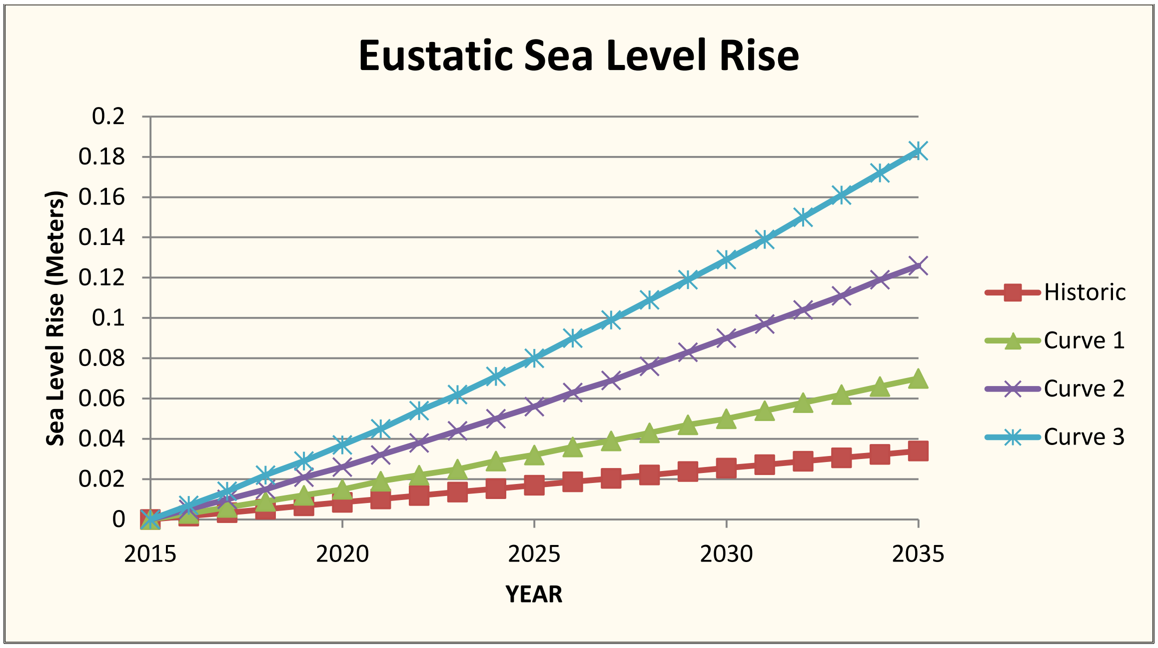


Figure 2-5. Eustatic Sea Level Rise Curves

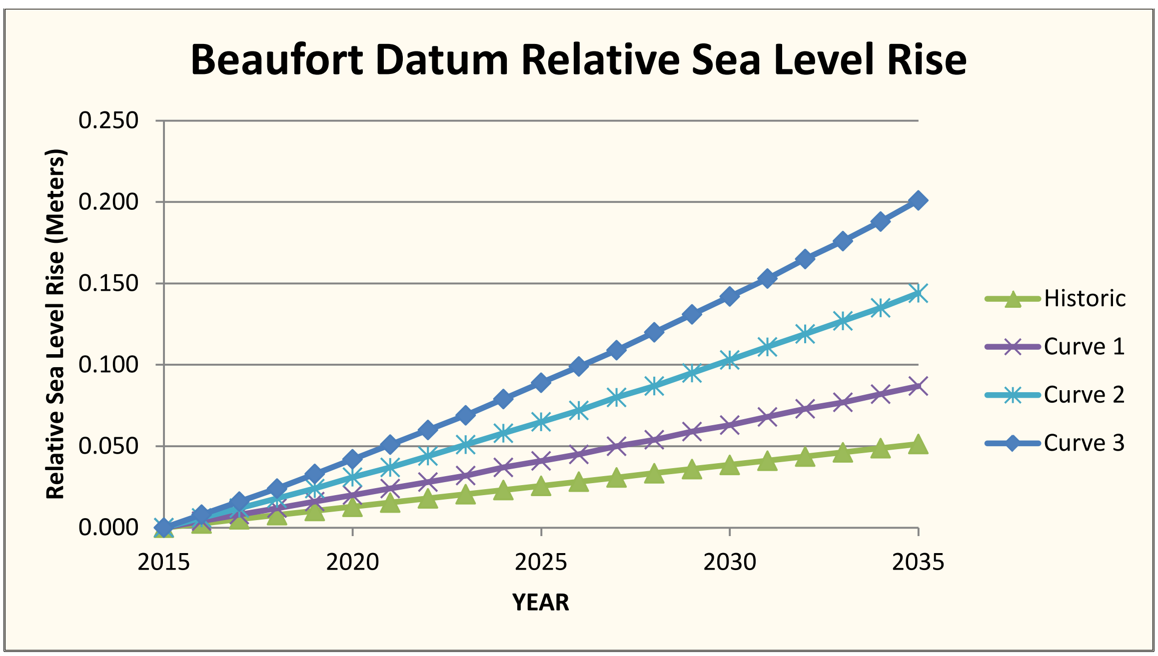


Figure 2-6. Relative Sea Level Rise Curves

2.5 Future Without Project Condition

The projected future conditions in the absence of a management plan, or the No Action Plan, represent the continued maintenance of the Morehead City Harbor without a DMMP. Until approval of the IOP in 2009, the disposal plan included disposal in and pumpout from Brandt Island. However, as evidenced by the last pumpout in 2005, Brandt Island contains large quantities of fine-grained material in addition to coarse-grained material. Due to the presence of these fine-grained sediments in Brandt Island and the high cost to separate this material from the remaining coarse-grained material, it is no longer economically feasible to do the Brandt Island pumpouts. This change in management of dredged material from the Harbor resulted in the determination that a DMMP was needed. Until the DMMP could be completed, an interim plan was implemented to address updated dredged material data and the Brandt Island issue. The IOP is the interim plan. For purposes of this report, the IOP is considered the No Action plan, recognizing that further coordination to make it a permanent plan would be necessary. This means that existing disposal practices as approved in the IOP would continue, that existing sites would not be modified or expanded, and no new sites would be constructed. The current dredged material disposal methods, as described in Section 2.1 (Existing Conditions), would continue as long as the currently used disposal sites remain viable. In summary, all dredged material from Morehead City Harbor would continue to be disposed of in Brandt Island until it reaches capacity in 2028, on nearby beaches, in the existing nearshore placement site, or in the ODMDS.

Without the DMMP, there would be no comprehensive approach for managing dredged material or for meeting disposal needs. The DMMP identifies long-term disposal options for meeting dredged material disposal capacity needs for the Morehead City Harbor over a 20-year planning period. These disposal options comprise the least costly plan that is consistent with sound engineering practices and meets all federal environmental requirements. The DMMP complies with NEPA requirements by providing an assessment of the environmental impacts associated with implementation of the recommended dredged material management alternatives. Without the DMMP, planning for the disposal of dredged material would continue on a case-by-case basis. The following conditions may exist without the DMMP:

- Reduced reliability for navigation of the Harbor
- Less efficient budget planning
- Difficulty in maintaining adequate navigable depths in a timely manner
- Longer response time for dealing with urgent shoaling situations
- Less efficient expenditure of public funds for Harbor O & M
- Repeated regulatory compliance reviews and approvals for similar O&M activities
- Greater difficulty in identifying and evaluating cumulative environmental effects

Inefficient budgetary planning and expenditure of public funds can lead to under-funding for important programs. Inability to maintain the Harbor to authorized depths in a timely manner can negatively impact commercial and recreational usage of the Harbor and indirectly impact economic benefits to business and tourism interests. Repeated regulatory reviews and approvals for similar dredged material management activities can impact maintenance schedules and unnecessarily increase the review time commitment for regulatory agencies. Finally, continued maintenance of the Harbor without a DMMP would not meet the federal requirement that every federal navigation project have a DMMP that demonstrates dredged material disposal capacity for a minimum of 20 years.

2.6 Goals

Identification and consideration of the problems and opportunities of the study area in the context of federal authorities, policies, and guidelines resulted in the establishment of the following goals:

- Develop a 20-year plan for disposal of dredged material from Morehead City Harbor that is economically warranted, cost effective, environmentally acceptable and uses sound engineering techniques (ER 1105-2-100).

- Increase the effectiveness of navigation Operation and Maintenance funds expended.

- Develop solutions that are protective of the environment through avoidance or minimization of impacts to cultural resources and natural resources, including fisheries, invertebrates, shorebirds, marine fish, marine mammals, and their habitats.

2.7 Constraints

- Applicable federal laws

- Applicable USACE policy and guidance, including, but not limited to the following:
    - DMMPs shall be conducted pursuant to existing authorities for individual project operation and maintenance, as provided in public laws authorizing specific projects. Where management plan studies disclose the need to consider expanding or enlarging existing projects, such studies may only be pursued under specific study authority or under Section 216 of the Flood Control Act of 1970.

    - Studies of project modifications needing congressional authorization, including dredged material management requirements related to the modification, will be pursued as cost shared feasibility studies with General Investigations funding. Where the need for such modifications are identified as part of dredged material management studies, operation and maintenance funding for the study of the modification should be terminated and a new feasibility study start sought through the budget process under the authority of Section 216 of the Water Resources Development Act (WRDA) of 1970.

3 ALTERNATIVES

3.1 No Action Plan (No DMMP)

The “No Action” alternative is used as a basis for comparison to the recommended or base plan. Because the study goal is to develop a plan to ensure dredged material disposal capacity for at least the next 20 years, the consequences of no action (i.e. no plan to ensure sufficient dredged material disposal capacity from 2015 to 2034) are particularly important because they define the need for the DMMP.

Until approval of the IOP in 2009, the disposal plan included disposal in and pumpout of coarse-grained material from Brandt Island. The Brandt Island pumpout served two purposes; it renourished local beaches and restored capacity in Brandt Island. When that plan was no longer feasible, it was determined that a DMMP was needed and an interim plan was implemented to address updated dredged material data and the Brandt Island issue. The IOP is the interim plan. Although the IOP was intended to be an interim plan, it is the only plan that has been approved by resource agencies and stakeholders. Implementation of the IOP beyond the three years for which approval was obtained requires further coordination.

The No Action Plan would not ensure that a 20-year disposal capacity exists for maintenance of Morehead City Harbor nor that disposal was being accomplished in the least costly manner, consistent with sound engineering practices and meeting environmental standards. Additionally, the past five years of operations under the IOP demonstrate that the IOP does not adequately maintain the channel and is not a sustainable plan. The full dimensions of the authorized channel cannot be achieved on a regular basis, resulting in ship traffic being forced to follow the deeper water along the west side of the channel, outside of the existing authorized channel.

3.2 Formulation of DMMP Measures

Pursuant to 33 C.F.R. § 335.4 the USACE undertakes operations and maintenance activities where appropriate and environmentally acceptable. All practicable and reasonable alternatives are fully considered on an equal basis. This includes the discharge of dredged or fill material into waters of the U.S. or ocean waters in the least costly manner, at the least costly and most practicable location, and consistent with engineering and environmental requirements. Pursuant to 33 C.F.R. § 335.7, federal standard means the dredged material disposal alternative or alternatives identified by USACE which represent the least costly alternatives consistent with sound engineering practices and meeting the environmental standards established by the 404(b)(1) evaluation process (Appendix H) or ocean dumping criteria.

The objective of the DMMP is to provide the least cost, engineeringly sound, environmentally acceptable alternative for disposal of maintenance dredged material from Morehead City Harbor for at least the next 20 years, beginning in fiscal year 2015. Beneficial uses of dredged material are powerful tools for harmonizing environmental values and navigation purposes. It is the policy of the USACE that all dredged material management studies include an assessment of potential beneficial uses for environmental purposes including fish and wildlife habitat creation, ecosystem restoration and enhancement and/or coastal storm damage reduction. Several of the measures considered for the DMMP represent beneficial uses of dredged material.

This section presents a detailed description of the measures that have been developed for evaluation in the DMMP and a brief description of measures that were eliminated from further study and the justification for their elimination. The Morehead City Harbor plans were formulated and categorized based on various sediment types and their location within the Harbor. As shown in Figure 2-2, the Harbor ranges have been divided into three categories: (1) fine-grained material less than 80% sand; (2) material that is between 80% and 90% sand and; (3) material that is greater than or equal to 90% sand.

On March 4, 2009, a public meeting was held to brief attendees on the Morehead City Harbor DMMP project and process, to solicit comments and input and to invite attendees to participate on the PDT. Attendees included representatives from state and federal resource agencies, interest groups, and stakeholders. Several attendees expressed an interest in participating on the PDT and have actively participated in the development of the DMMP. The PDT members are listed in Section 13 (Project Delivery Team). In addition to the public meeting and involvement by various resource agencies and stakeholders in the planning process, the USACE has also coordinated with the National Park Service regarding potential DMMP measures that may impact Cape Lookout National Seashore and in February 2011, NPS formally became a cooperating agency on the DMMP (Appendix D). Additional information regarding coordination is included in Section 5.1 NEPA Documentation and Coordination, and copies of all pertinent correspondence are found in Appendix D. Following identification of problems and opportunities, the PDT identified 21 potential DMMP measures (Table 3-1) for the Morehead City Harbor DMMP which resulted in over 100 dredging and disposal options to be analyzed for inclusion in the base plan (Tables 3-16 thru 3-20). Table 3-1 also identifies the beneficial use options that were considered. Analysis and screening of the measures during the plan formulation process resulted in the elimination of several of the disposal measures. The measures that remain feasible are described in detail in the following sections and are the basis for the proposed base plan. Those measures that were eliminated are discussed in Sections 3.2.5 (DMMP Measures Eliminated) and in Section 3.5.1 (Trade-Off Analysis) and were not further analyzed.

	Morehead City Harbor DMMP Alternatives & Measures	
#	**Description**	**Beneficial Use**
1	**No Action (No DMMP)**	NA
2	**Proposed DMMP (Measures Considered)**	NA
a	Brandt Island upland disposal site	No
b	Place coarse-grained material (≥90% sand) on Bogue Banks	Yes
c	Morehead City Ocean Dredged Material Disposal Site (ODMDS)	No
d	Expand nearshore (ebb tide delta) placement area west of Beaufort Inlet	Yes
e	Create nearshore (ebb tide delta) placement area east of Beaufort Inlet	Yes
f	Place Inner Harbor material ≥80% sand in nearshore placement areas	Yes
g	Expand and raise Brandt Island dike	No
h	Raise existing Brandt Island dike (no expansion)	No
i	Transfer Brandt Island material to ODMDS to regain capacity	No
j	Recycle Material in Brandt Island through Hydrocyclone Density Separation	Yes
k	Place coarse-grained material (≥90% sand) on Shackleford Banks	Yes
l	Continue to use existing nearshore placement area (no expansion)	Yes
m	Modify environmental windows	No
n	Construct colonial waterbird islands	Yes
o	Dispose of dredged material in Radio Island	No
p	Dispose of dredged material in Marsh Island	No
q	Use dredged material to create wetlands	Yes
r	Construct new upland disposal site	No
s	Brandt Island shoreline stabilization	Yes
t	Construct jetties at Beaufort Inlet	No
u	Modify existing groin on west side of Beaufort Inlet	No
v	Realign channels to improve navigation and reduce dredging	No

Table 3-1. Morehead City Harbor DMMP Alternatives and Measures

3.2.1 Brandt Island

Brandt Island is approximately 168 acres in size and located south of the existing Port of Morehead City, across the Morehead City Harbor Channel (Figure 1-3). The Island has been used as a disposal area since 1955 and is divided from the Bogue Banks barrier island by the narrow Fishing Creek. Immediately to the southeast is the Fort Macon U.S. Coast Guard facility and Fort Macon State Park.

Brandt Island is owned and has previously been used as a sand-recycling site by the North Carolina State Ports Authority and dedicated for the purpose of dredged material disposal. Brandt Island has a present capacity of about 3 million cubic yards. In 1986, 1994, and 2005 approximately 3.9 million, 2.5 million, and 2.9 million cubic yards, respectively, of dredged material were pumped out of Brandt Island and disposed of on the beaches of Bogue Banks from Fort Macon State Park to Atlantic Beach.

Brandt Island has historically received material that is both suitable and unsuitable for beach disposal. In 2005 a cross dike was constructed inside Brandt Island at an elevation of 14 feet mean sea level (msl) for purposes of segregating the unsuitable material from the coarse-grained material suitable for beach disposal. However, as previously stated, due to the problems associated with the last Brandt Island pumpout in 2005, since that time, only fine-grained dredged material has been disposed of in Brandt Island. Coarse-grained material has been disposed of on the beaches of Fort Macon State Park and Atlantic Beach, in the existing nearshore placement area west of Beaufort Inlet (Nearshore West), in the ODMDS, or on Pine Knoll Shores (Figure 1-5, west of Atlantic Beach) as part of a beneficial use of dredged material project (Section 933). There are no plans for future pumpouts from Brandt Island to the beach.

The existing Brandt Island disposal area encompasses approximately 64 acres and has a controlling top of dike elevation of approximately 37 feet msl. It is assumed that 2 feet of freeboard will be required at all times during disposal operations and water and dredged material will not be allowed above elevation 35 feet msl. within the disposal area. The existing available storage volume below elevation 35 feet msl. is approximately 3 million cubic yards.

Management of Brandt Island**.** Brandt Island is currently being operated in a one-cell configuration with only fine-grained material from the Inner Harbor being disposed of there. The PDT considered modification of future disposal practices at Brandt Island, by only disposing of fine-grained silty material from portions of the Northwest and West Legs in Brandt Island rather than using it for disposal of all material from the Inner Harbor, including all of the East Leg and North Range C. The eastern half of the West Leg (referred to as West Leg 2) and North Range C contain a mix of fine-grained and coarse-grained material that is ≥80% sand. Because these portions of Inner Harbor contain higher percentages of sandy material than other areas of the Inner Harbor, the DMMP includes an option to keep this sandy material in the littoral system by placing it in the Nearshore West (existing and expanded) and in the proposed nearshore placement area off of Shackleford Banks (Nearshore East). This is addressed in more detail in Section 3.2.4 Ebb Tide Delta. The amount of coarse-grained material in the Inner Harbor (West Leg 2 and North Range C) is quite small (~152,000 cubic yards every 3 years) whereas the amount of fine-grained material is about ~362,000 cubic yards every 3 years. So even if it was feasible to place the coarse-grained material in the nearshore areas, Brandt Island would still reach capacity in 2034. This is based on disposal of the following approximate quantities: 15,000 cubic yards annually from the non-federal berths, 362,000 cubic yards from the federal channel every 3 years, and 75,000 cubic yards from the Fort Macon Coast Guard Station every 6 years. If this option is not implementable due to costs, Brandt Island is expected to reach capacity in 2028. This is based on the same quantities above with the addition of the coarse-grained material from the Inner Harbor, which is about 152,000 cubic yards every 3 years. For these reasons, potential measures that would extend the life of Brandt Island were considered as discussed below. Two dike alignments with varying dike heights were analyzed. One option considered dike raises to elevations 42', 47', 52' and 55' along the present alignment. However, as discussed in Section 3.2.5 DMMP Measures Eliminated, raising the dikes along the current alignment is not economically justified. Other measures considered an expanded alignment with dike raises also to elevations of 42', 47', 52' and 55'. An expanded dike would have the standard 15-foot top width and 3 horizontal to 1 vertical side slopes. The dike alignment would be adjusted as needed to minimize the amount of fill required. The toe of the expanded dike alignment would be designed to avoid wetlands and to also allow a construction buffer (work area) adjacent to the toe. Specific information for the subsurface investigation, lab testing, dike design, and the stability analysis are contained in the Geotechnical Appendix B.

3.2.2 Beach Disposal

One measure which has been used historically for disposal of coarse-grained material (greater than or equal to 90% sand) dredged from the Morehead City Navigation Channel is beach disposal along various sections of Bogue Banks. One reason for this was to offset potential impacts to the adjacent shorelines by placing some of the coarse-grained material on the beach. In the Winds, Waves, and Shore Processes appendix of the USACE 1976 General Design Memorandum for deepening of portions of the project to 42 feet, it was determined that "channel deepening has definitely decreased natural by-passing of sediment across the Beaufort Inlet Ocean Bar" (USACE 1976). At that time, although the primary erosive effects of the deepening were thought to be experienced on Shackleford Banks, the decision was made to periodically pump Inner Harbor material from Brandt Island onto the Atlantic Beach shoreline. This was done in order offset potential impacts of the navigation project to beachfront development along Bogue Banks . The amount to be pumped out, an anticipated annual equivalent of 135,000 cubic yards a year, was predicted to be "sufficient to stabilize" the Atlantic Beach shoreline. It should be noted that Shackleford Banks is managed by the National Park Service (NPS). Although new information regarding navigation channel impacts on Shackleford Banks has caused the NPS to investigate the beach disposal option in compliance with its policies, disposal of material on Shackleford Banks was previously considered not consistent with NPS Management Policies (2006). Therefore no material has been disposed of there to date. The 2001 Section 111 Report performed to examine whether the Morehead City Harbor project had adversely impacted adjacent beaches concluded that disposal of sand on the beaches of Fort Macon State Park and Atlantic Beach was "an integral part of the operation and maintenance of the project," and that the disposal of approximately 5 million cubic yards of material between 1978 and 2001 "provided more than adequate compensation or mitigation for this possible impact" (USACE 2001).

Material has been disposed of on Bogue Banks in various locations on ten occasions by the USACE since the deepening of the channel in 1978. The total quantity disposed of to date by the USACE is approximately 16,108,200 cubic yards and is summarized in Table 3-2.

Placement	Channel Depth	Date	Quantity	Location	Source
1	-40 feet m.l.w.	1978	1,179,600	Ft. Macon State Park Shoreline	Navigation Channel
2	-40 feet m.l.w.	1986	4,168,637	Eastern 3.6 miles of Atlantic Beach	Brandt Island/Navigation Channel
3	-45 feet m.l.w.	1994	4,664,400	Ft. Macon and Atlantic Beach	Brandt Island/Navigation Channel
4	-45 feet m.l.w.	2002	209,300	Ft. Macon	Navigation Channel
5	-45 feet m.l.w.	2004	776,000	Salter Path/Indian Beach	Navigation Channel
6	-45 feet m.l.w.	2004/2005	2,920,729	Ft. Macon and Atlantic Beach	Brandt Island
7	-45 feet m.l.w.	2007	509,566	Pine Knoll Shores	Navigation Channel
8	-45 feet m.l.w.	2007	184,828	Eastern Ft. Macon	Inner Harbor
9	-45 feet m.l.w.	2008	148,393	Just west of Atlantic Beach Town Lir	AIWW
10	-45 feet m.l.w.	2010/2011	1,346,700	Ft. Macon and Atlantic Beach	Navigation Channel

Table 3-2. Summary of Dredged Material Disposed of on Bogue Banks

As part of the DMMP, an evaluation of possible disposal locations and quantities along Bogue and Shackleford Banks was made. The premise of the evaluation was to determine the annual volume loss of the eastern end of Bogue Banks between stations 77 and 112 (Figure 3-1) and along the western end of Shackleford Banks between stations 293 and 460 (Figure 3-2) related to the dredging of the navigation channel. These loss rates were used to determine the optimal quantity from future dredging events to ameliorate the future losses computed on the eastern and western ends of the adjacent islands. The area along Bogue Banks analyzed to determine volumetric change was established based on the historic beach disposal areas for the navigation project. The USACE Section 111 report (USACE, 2001) determined that the historic beach disposal activities have ameliorated any shoreline impacts that may be related to the dredging of the navigation channel. Additionally, the Section 111 report determined that there were no significant changes to the shoreline recession rate beyond the Atlantic Beach town limits that are related to the navigation project. As a result of this determination, mitigation for the remainder of the island was not warranted . The region of the beach along Shackleford Banks used to determine associated volumetric losses was determined based on the results from the sediment transport studied included in the Section 111 report. This study found that rates were predominately westerly through the western 16,600 feet of the island. Beyond this distance there was some variation between easterly and westerly transport. The 16,600 foot distance approximately corresponds to the area between stations 293 and 460 along Shackleford Banks. The following volumes computed for these areas do not separate volume loss resulting from the navigation channel from the loss that would naturally occur with no project in place. Given the length of time that the navigation project has been in place at Beaufort Inlet there was insufficient data available pre-project to determine the natural background erosion rate. As a result, the loss volumes calculated and corresponding beach disposal quantities are slightly conservative.

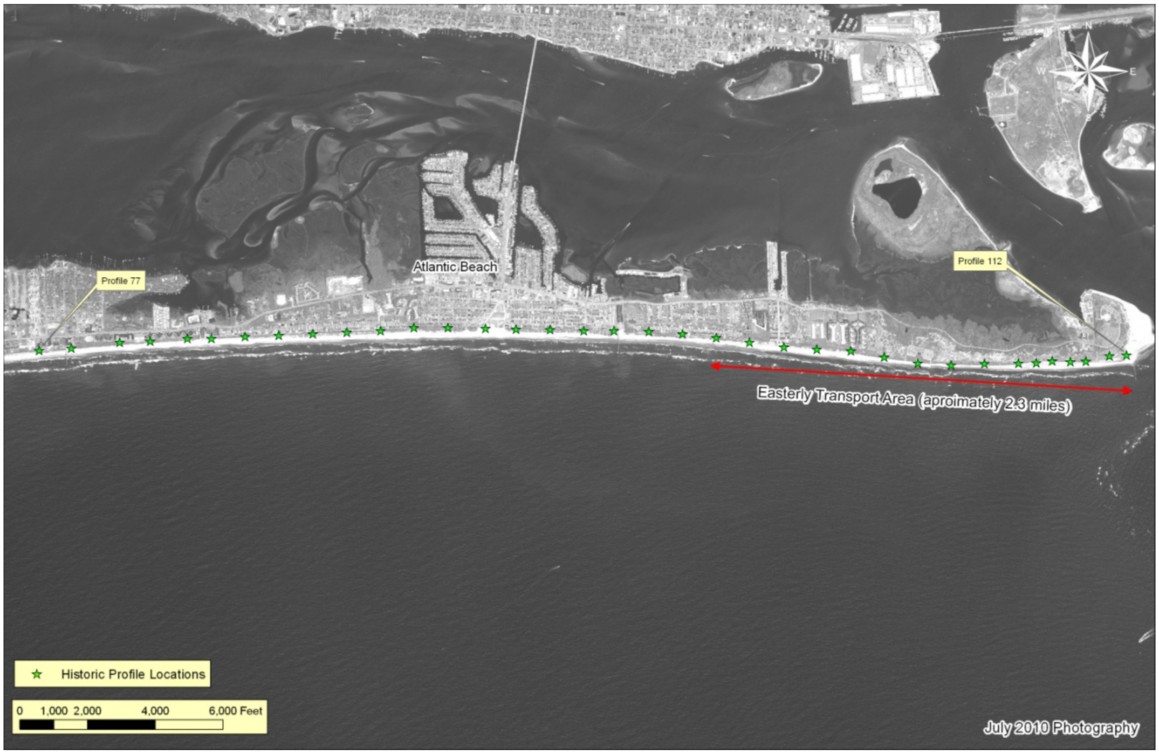


Figure 3-1. Bogue Banks Volumetric Analysis Area

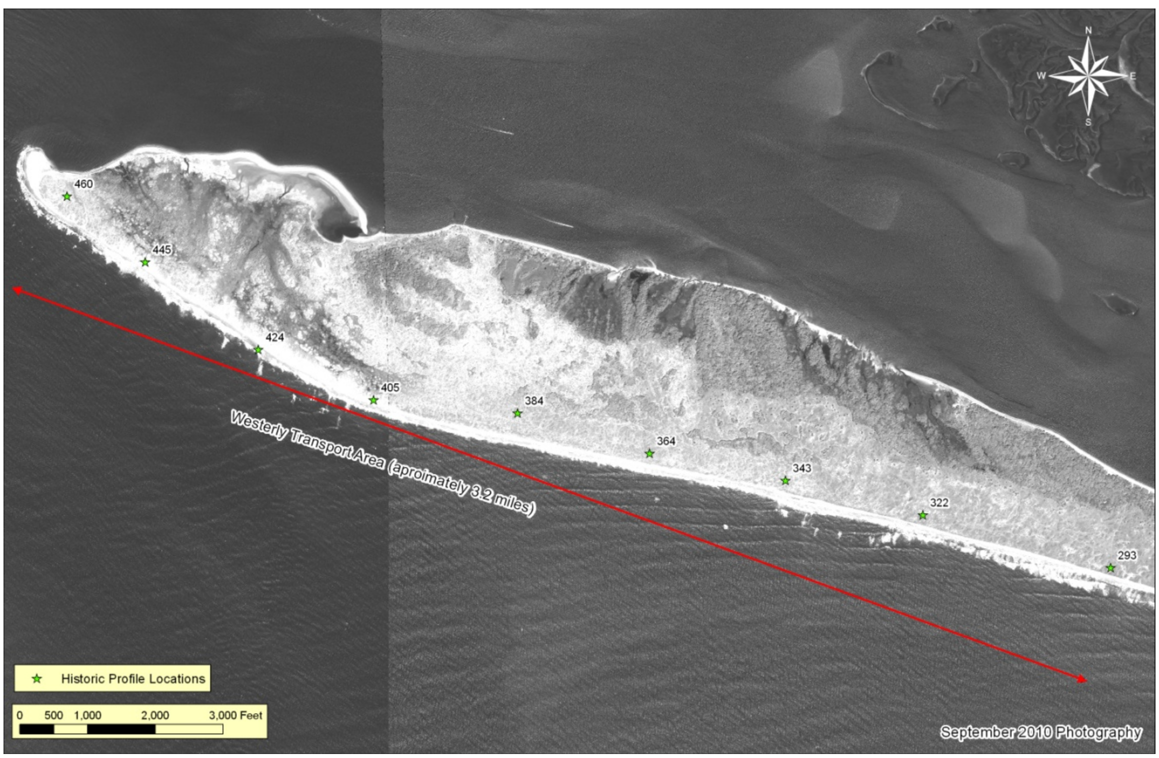


Figure 3-2. Shackleford Banks Volumetric Analysis Area

Volumetric analysis of the east end of Bogue Banks, including Atlantic Beach and Fort Macon shorelines, was based on a collection of eight surveys including: December 2003, June 2004, May 2005, May 2006, May 2007, July 2008, June 2009 and the most recent survey of June 2010. Surveys within this area are typically spaced 1000 feet apart on the beach front portions of the island with a tighter typical spacing of 500 feet near the inlet complex. Offshore coverage typically extends to approximately 2000 feet offshore, however, offshore coverage is greater with the most recent surveys (since 2006) extending out to 2500 feet and beyond (Figure 3-3).

The beach profile surveys were analyzed using BMAP (Beach Morphology Analysis Program) (Sommerfield 1994) to determine unit volume changes over time for each profile of interest. Volumes were calculated between landward and seaward points common to all surveys at the individual profile locations. These locations varied along the beach depending on the available survey coverage.

To illustrate trends in volume change within the eastern end of Bogue Banks, Figure 3-4 shows the volume change over time with respect to the base year survey of December 2003. The values for each displayed time period within the graph are the total measured volume changes for the eastern end of the island included in the analysis (Station 77-112) relative to December 2003. This type of plot allows comparison of volumetric changes over time as well as comparison of volumetric changes from survey to survey. To account for a small disposal of material (184,828 cubic yards) along the beach at Fort Macon, this quantity was subtracted from all volumetric measurements for each of the surveys following the March 2007 disposal. Two things are clearly shown within Figure 3-4. The first is the impact of the Brandt Island pumpout which occurred between November 2004 and February of 2005 and disposed of nearly 2.4 million cubic yards of sand along Bogue Banks. The result of the disposal was an increase in volumetric quantities within the analysis area as related to the December 2003 survey.

The second item that is clear from Figure 3-4 is the substantial loss of material along the eastern end of the island following the Brandt Island disposal operation through June 2009. The most recent survey in June 2010 shows a slight increase in volume within this area, reversing the most recent trend. Losses within the region between the first post-fill disposal survey and the most recent survey of June 2010 show that the area has lost approximately 916,600 cubic yards of material in total. Due to the limited number of historic surveys along the existing baseline stationing scheme prior to the beach disposal in 2004, the loss rate for the area was computed using the May 2005 through June 2010 surveys exclusively. This was done by computing a least-squares regression through the volumetric data for these years. The results of the regression analysis found that the area of Atlantic Beach and Fort Macon is eroding material at a rate of approximately 218,800 cubic yards per year.

Figure 3-5 displays the volumetric changes since December 2003 for each profile within the volumetric analysis area for Bogue Banks. This plot clearly shows the influence of the 2004 beach disposal and the subsequent erosion of the material. Volumetric change displayed within the figure shows that a section of the western end of the analysis area (Stations 93-104) has eroded rapidly following the beach disposal while the surrounding areas have remained somewhat stable following the disposal. This area of more rapid erosion is approximately centered on the nodal transport zone identified in the Section 111 report. The stability of the surrounding areas may be related to the diffusion of material disposed of between Stations 93 and 104 toward the eastern and western ends of the area of interest.

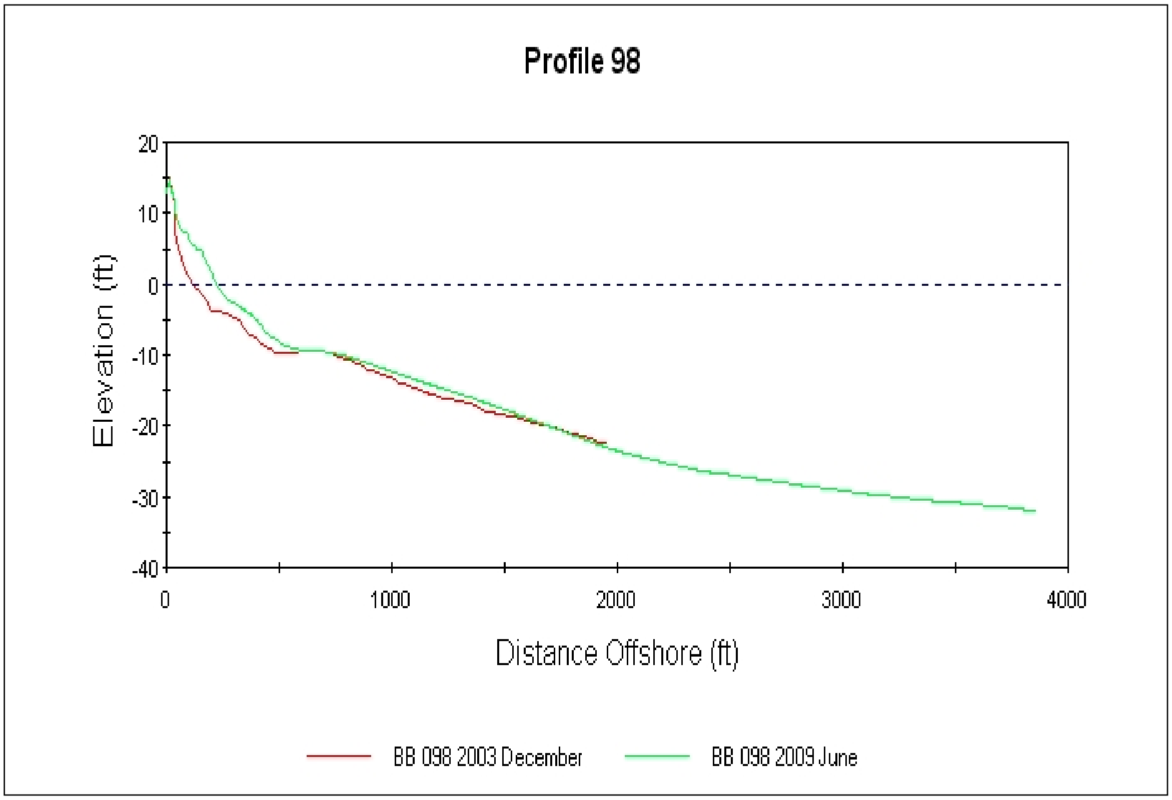


Figure 3-3. Typical Survey Coverage

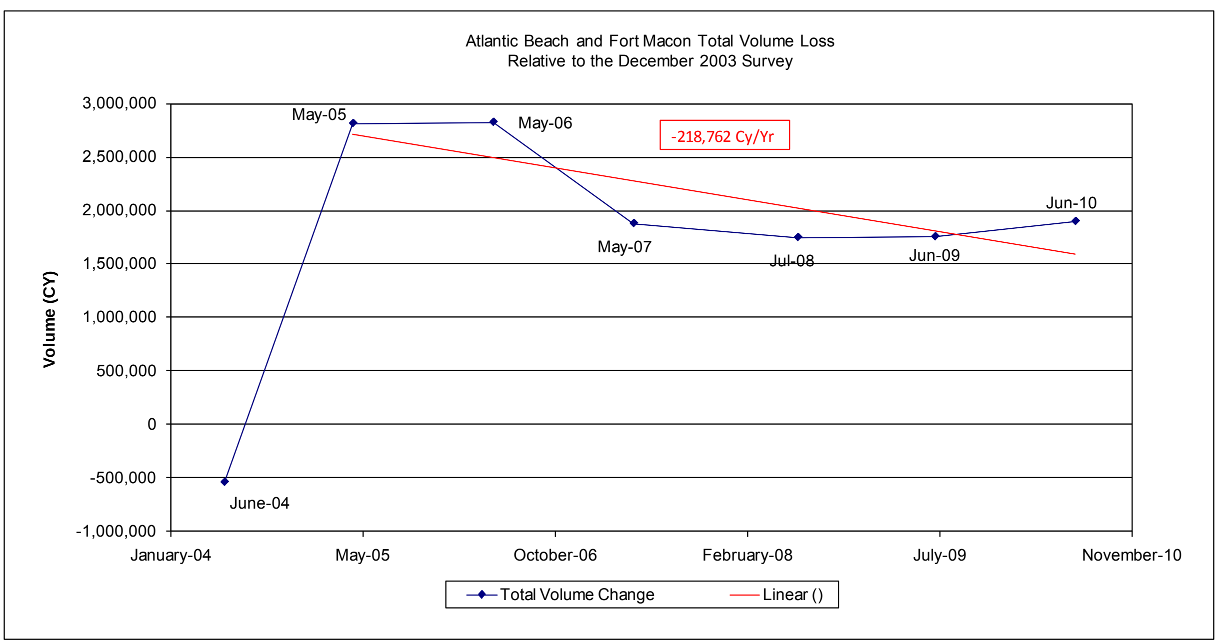


Figure 3-4. Bogue Banks Total Volume Loss (Stations 77-112)

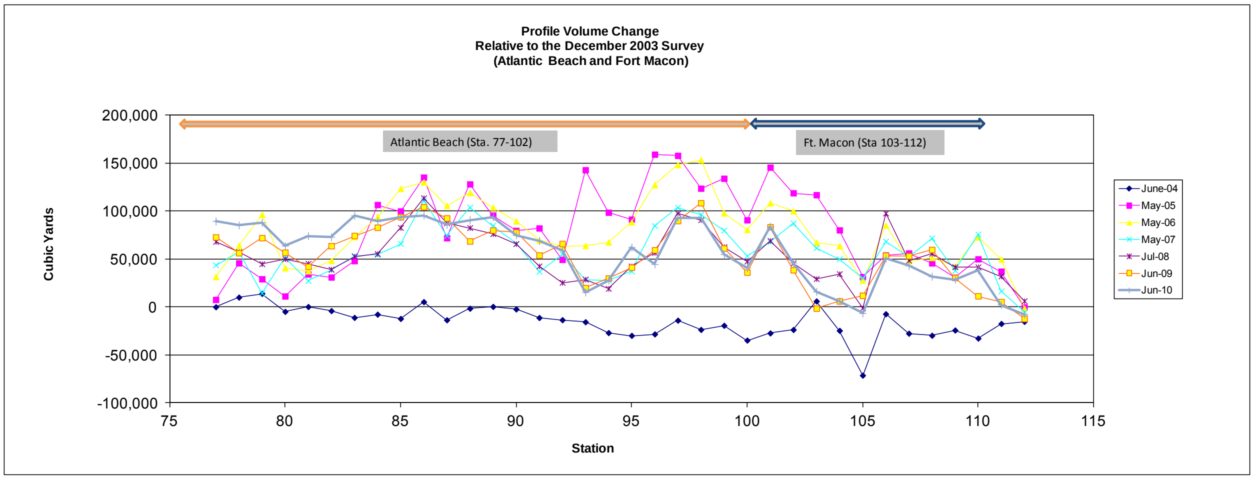


Figure 3-5. Bogue Banks Volume Loss by Station

Volumetric analysis of Shackleford Banks is based on a more limited survey database, consisting of only five surveys. The surveys included in the analysis were the October 2000, May 2006, June 2008, August 2009, and the April 2010 survey, which had relatively consistent onshore and offshore coverage. The spacing of the profile coverage along Shackleford Banks is more irregular than on Bogue Banks with the spacing varying between 1,500 and 2,700 feet. Offshore extent of the survey coverage varies from approximately 2,700 feet to more than 5,000 feet with coverage being greater near the inlet and reducing toward the middle of the island (Figure 3-6).

The beach profile surveys at Shackleford Banks were analyzed in the same way the profiles along Bogue Banks were analyzed. Volumes were calculated between landward and seaward points common to the surveys at each profile location above a common datum. To develop the annual volumetric change along the western end of the island (Stations 293 to 460), the computed volumes were compared and plotted relative to the base year condition of October 2000 (Figure 3-7). These calculations show that the area between Stations 293 and 460 included in this analysis has lost approximately 1,516,800 cubic yards of material since the base year survey of October 2000. As seen in Figure 3-7, the western end of Shackleford Banks has lost material each year surveyed, with no indication of stabilization as recently observed along the western end of Bogue Banks. A least-squares regression computed through these computed volumetric changes shows the loss is approximately 166,450 cubic yards per year over the 9.5 years included in the analysis.

Figure 3-8 displays the volumetric changes relative to the October 2000 survey for each profile along Shackleford Banks. From this plot it is clear that the majority of the island has eroded since October 2000, with the most significant erosion occurring in the western portion of the island at Station 424. The eastern end of the island, between Stations 41 and 59, has actually experienced volumetric increases since October 2000.

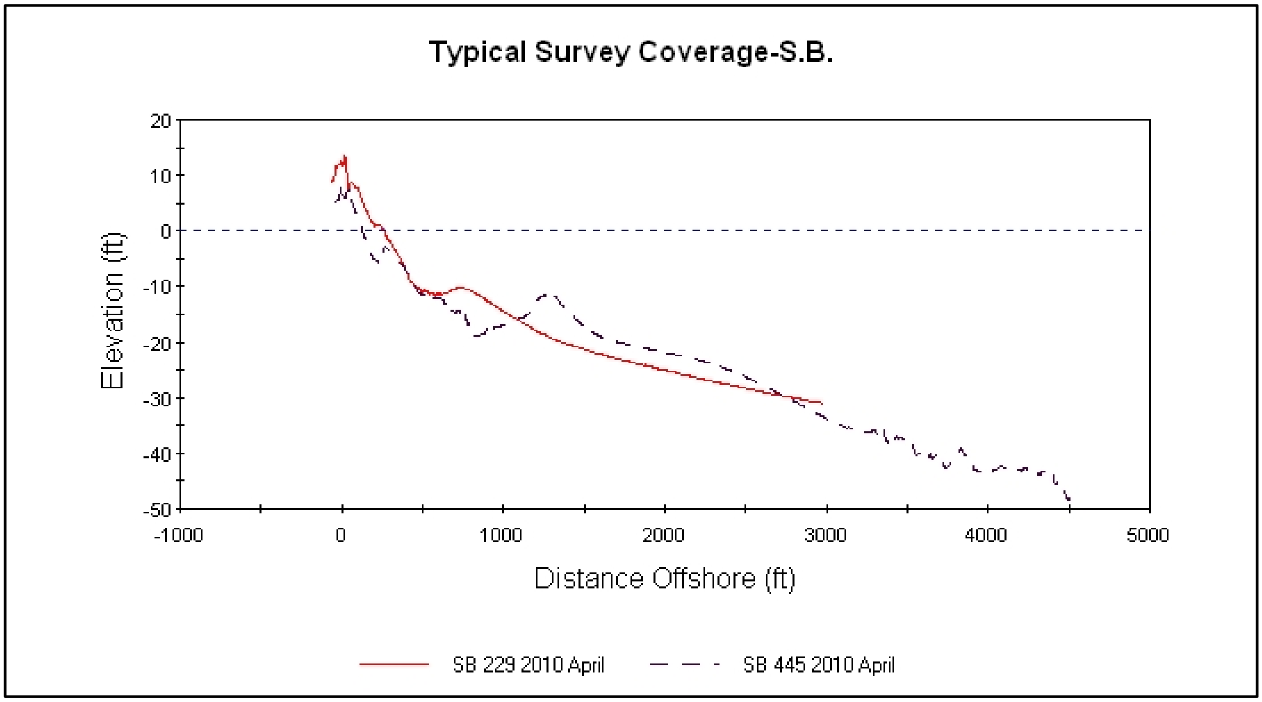


Figure 3-6. Shackleford Banks Typical Survey Coverage

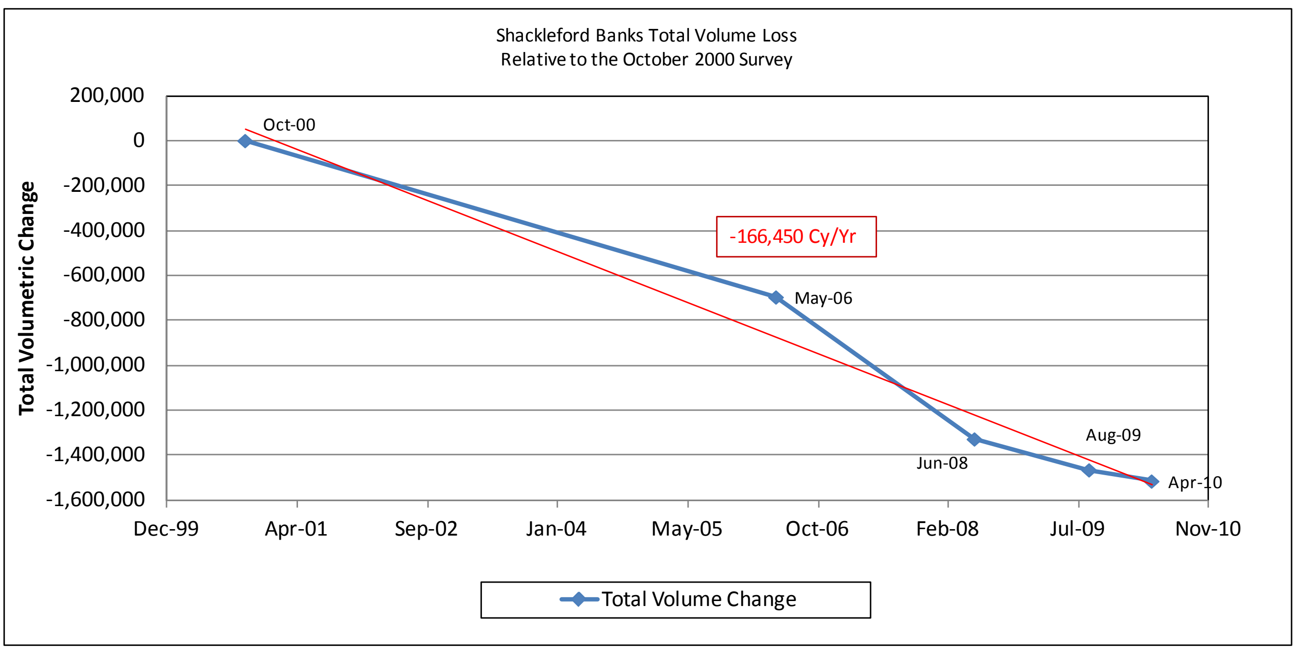


Figure 3-7. Shackleford Total Volume Loss (Stations 293-460)

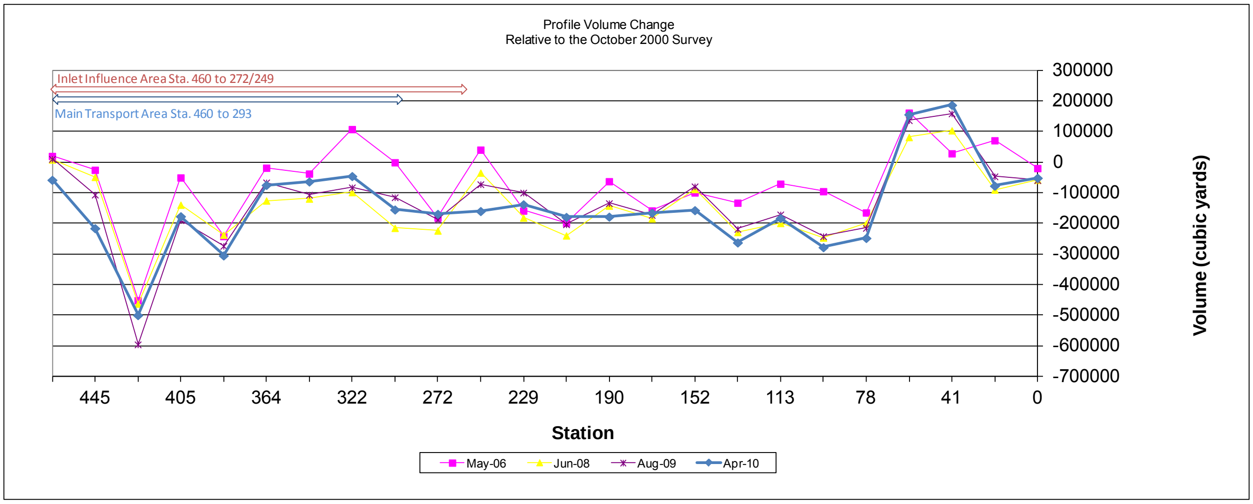


Figure 3-8. Shackleford Banks Volume Loss by Station

Recommendations for future beach disposal operations along Bogue Banks would be based on the volumetric loss within the area of Atlantic Beach and Fort Macon. It is recommended that future beach disposal operations place material primarily between Stations 77 and 107 (Figure 3-9) as the base location. Any material in excess of the amount needed to offset losses between stations 77 and 107 could be disposed of farther west in areas that need material. The quantity and location of future disposal event s will be based on changes observed through the monitoring program and should be sufficient to ameliorate losses that have occurred between beach disposal operations. However, dredged material quantities will be subject to navigation priorities and the limitations of available funding for dredging the navigation channel and will fluctuate from year to year.

Disposal of material along the beaches of Shackleford Banks should also be based on the volumetric loss measured between disposal events. Figure 3-10 displays the potential area designated for disposal of beach quality sand. The potential disposal area is slightly east of the area used to determine volumetric changes. This eastward offset is necessary to reduce rapid shoaling of the material directly back into the navigation channel while still providing sufficient beach length to place the necessary quantities. Material disposed of within this area will be subject to the predominant westerly transport rates which will naturally move material toward the westernmost part of the island that does not receive sand.

Additionally, future disposal of material within the designated limits along Shackleford Banks will be monitored to measure their impact on shoaling rates within Beaufort Inlet. Adjustments to fill quantities and disposal locations within the designated areas along Shackleford Banks will be made to minimize impacts on inlet shoaling patterns.

Comparison of the volumetric losses calculated earlier in this section shows that the recent loss trends for both islands are relatively similar. The loss rate for the Bogue Banks side of the inlet is approximately 218,800 cubic yards per year, while a similar loss rate along Shackleford Banks of 166,450 cubic yards per year was also calculated. These annual losses when converted to percentages show that 57% of the material is lost from the Bogue Banks side of the inlet and 43% of the total losses come from the Shackleford Banks side. With this approximate 57/43 split of sediment entering the navigation channel from both the east and west, material should be returned to the beaches in similar ratios during future beach disposal operations. Following the initial disposal, these ratios may be reevaluated based on the performance of the material placed. This should occur just prior to future disposal events to ensure equitable distribution of available material to both islands. The National Park Service (NPS) is the agency responsible for the management of Shackleford Banks, and has determined that only the quantity of material lost from the island as a result of the navigation channel can be returned to the beaches of Shackleford Banks. Quantities for the initial fill will be determined based on discussions with the NPS prior to dredging operations and shall not exceed the three year historic loss rate of volume of 499,350 cubic yards. The maximum amount of material to be disposed of along the beaches of Shackleford Banks following the initial fill will be the historic volumetric erosion rate of 166,450 cy/year multiplied by the duration between beach disposal events. There is the potential that any dredged quantities in excess of that amount could be placed west of the described base disposal area on Bogue Banks (Station 77-107). Figure 3-9 also displays the extended beach disposal area for any excess material, which is between Stations 59 and 76 on Bogue Banks. Specific locations for disposal west of the Bogue Banks base location would be determined just prior to the commencement of dredging activities to determine the area that produces the greatest benefits while minimizing associated pumping costs.

Another factor that will be considered when developing quantities to be disposed of along the eastern end of Bogue Banks is the migration of the spit at the eastern end of the island. Recent aerial photography indicates that the spit has experienced significant growth since 1996 and appears to be migrating east toward the navigation channel. Growth of the spit in relation to beach fill disposal should be monitored. Adjustments may be needed in the disposal locations of material within the easterly transport zone if it appears that material disposed along the beach is migrating toward and attaching to the spit which may cause restrictions within the navigation channel.

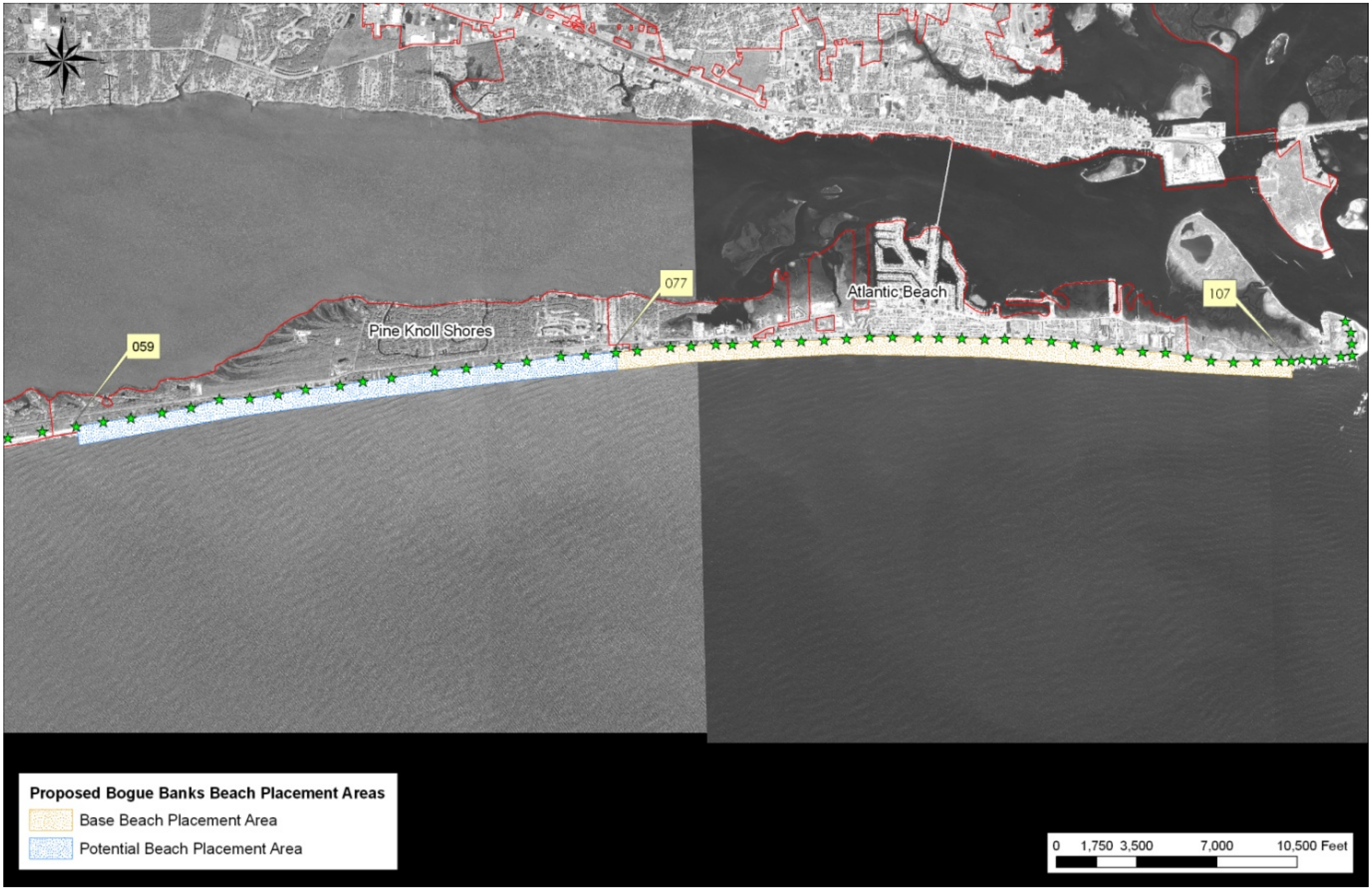


Figure 3-9. Proposed Bogue Banks Disposal Area

Figure 3-10. Proposed Shackleford Banks Disposal Area

3.2.3 Ocean Dredged Material Disposal Site (ODMDS)

The transportation and disposal of dredged material in ocean waters, including the territorial sea, is regulated under the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA) (Public Law 92-532, 86 Stat. 1052, 33 U.S.C. §§1041 et seq.) as amended by Title V of the Water Resources Development Act of 1992 (WRDA 92; Public Law 102-580). Section 102(a) of MPRSA authorizes the USEPA to establish and apply regulations and criteria for ocean dumping activities. Consequently, the USEPA issued in October, 1973, and revised in January, 1977, Ocean Dumping Regulations and Criteria (40 CFR 220-238). These regulations establish control of ocean dredged material disposal primarily by two activities, designation of sites for ocean dumping and the issuance of permits for dumping.

The MPRSA Section 102(c) authorizes USEPA to designate recommended sites for ocean dredged material disposal sites. An ocean dredged material disposal site (ODMDS) is a precise geographical area within which ocean disposal of dredged material is permitted or authorized under conditions specified in MPRSA Sections 102 and 103. The designation of an ocean dredged material disposal site by EPA is based on compliance with general (Section 228.5) and specific (Section 228.6(a)) site evaluation criteria. Final site designation under MPRSA Section 102(c) must be based on environmental studies of each site and on historical knowledge of the impact of dredged material disposal on areas similar to such sites in physical, chemical, and biological characteristics. The USEPA has the primary responsibility for site designation. A site may be selected by the USACE under MPRSA Section 103(b), with USEPA concurrence, if no USEPA designated site is available.

The transportation of dredged material for the purpose of disposal into ocean waters (i.e. the actual use of the designated site) is permitted by USACE (or authorized in the case of federal projects) under MPRSA Section 103(e) applying environmental criteria established in USEPA's Ocean Dumping Regulations and Criteria. The MPRSA Section 104(a)(3) provides that ocean disposal of dredged material can occur only at a designated site and Section 103(b) requires the USACE to utilize dredged material disposal sites designated by USEPA to the maximum extent feasible. Prior to issuing a dredged material permit or authorizing a federal project involving the ocean disposal of dredged material, the USACE must notify USEPA, who may disapprove the proposed disposal.

The U.S. Coast Guard (USCG) is assigned responsibility under MPRSA to conduct surveillance of disposal operations to ensure compliance with permit conditions and to discourage unauthorized disposal. The USCG recognizes that the USACE has the primary surveillance and enforcement responsibilities over federally contracted actions associated with federal navigation projects. The USCG retains responsibility for surveillance of activities not associated with federal navigation projects.

Morehead City Ocean Dredged Material Disposal Site (ODMDS). The Morehead City ODMDS (Figure 1-5) was designated by USEPA pursuant to Section 102(c) of the Marine Protection, Research, and Sanctuaries Act of 1972, as amended, as suitable for the ocean disposal of dredged material. The final rule was promulgated by USEPA on 14 August 1987 (52 FR 30360), effective 14 September 1987. The boundary coordinates (NAD 27 Geographic) for the Morehead City ODMDS are:

34^0 38'30" N 76^0 45'00" W
34^0 38'30" N 76^0 41'42" W
34^0 38'09" N 76^0 41'00" W
34^0 36'00" N 76^0 41'00" W
34^0 36'00" N 76^0 45'00" W

The site is located just beyond 3 nautical miles offshore (beyond 3 nautical miles from the baseline of the territorial sea) of Morehead City, North Carolina. The Morehead City ODMDS has an area of about 8.0 square nautical miles. Depths within the ODMDS range from about -30 to -55 feet local mean low water (mlw) based on a composite of bathymetric surveys which include data from 1995 to 2011. Depths are shallowest in the northern (inshore) portion and gradually deepen to the south (offshore). Approximately 60 % of the area is greater than -50 feet (mlw). The bathymetry is essentially flat except for slight mounds of dredged material in the northeast third and middle of the ODMDS due to previous dredged material discharges and the influence of the Beaufort Inlet ebb tide delta.

Material was excavated from the Morehead City ODMDS by Carteret County as a borrow source for nourishment of the Bogue Banks beaches in 2004 and 2007 following Hurricanes Isabel and Ophelia, respectively. Approximately 1.2 million cubic yards of sand were removed from the northeast corner of the Morehead City ODMDS during those two events by hopper dredges and pumped onto the Bogue Banks beaches.

Disposal of dredged materials in the ocean has been associated with the Morehead City Harbor federal navigation project for many years. Federal dredging projects in Morehead City Harbor began in 1910. Continued use of the Morehead City Harbor navigation channel depends on annual maintenance dredging. Only one non-federal maintenance dredging and ocean dredged material disposal permit (permitted pursuant to Section 103 of MPRSA) has taken place in the Morehead City Harbor area, that being associated with the State maintained portions (berths) of the North Carolina State Ports.

The placement of dredged materials in the ocean off Beaufort Inlet since 1995 is documented in Table 3-3. Estimated volumes in Table 3-3 were derived from vessel disposal records provided by dredging contractors for ocean placement verification. They are not based on channel surveys. Since 1987 (the date of site designation) ocean disposal of dredged materials from the Morehead City Harbor federal project channels has occurred in the Morehead City ODMDS. Beginning in 1995, sediments dredged during the maintenance of the Morehead City Harbor navigation channels were also placed in the Morehead City Harbor nearshore placement area off Bogue Banks, or more infrequently, directly on Bogue Banks beaches. The Nearshore Placement Area is discussed further in Section 3.2.4. Accordingly, the quantity of dredged material being transported to the ODMDS for disposal has declined as compared to the pre-1995 levels.

As mentioned above, the Morehead City ODMDS has been used as a borrow area for Bogue Banks beach replenishment. Sand from the ODMDS has been dredged and subsequently discharged as beach fill. Future use of dredged material from the ODMDS for beach replenishment is possible.

Bathymetric surveys have indicated that the sandy and coarse dredged materials historically disposed of within the Morehead City ODMDS have the potential to mound appreciably when specific areas are repeatedly used for disposal. Such mounds may limit future use of specific areas of the ODMDS and may pose impairment to navigation including use by hopper dredges. These limitations should be minimized to the extent possible.

Morehead City ODMDS	
Calendar Year	**Quantity (Cubic Yards)**
1987	544,000
1988	691,000
1989	539,000
1990	592,000
1991	832,000
1992	209,000
1993	628,000
1994	715,000
1995	636,000
1996	0
1997	1,143,000
1998a	270,000
1998b	210,000
1999	759,000
2000	150,000
2001	719,000
2002	0
2003	283,000
2004	0
2005	63,000
2006	469,000
2007	537,000
2008	395,109
2009	869,800
2010	0
2011	472,199
TOTAL	**11,726,108**

Table 3-3. Morehead City ODMDS Site Use by Year

Morehead City ODMDS Site Management**.** As documented in the Site Management and Monitoring Plan (SMMP), dated February 2010 (USEPA and USACE 2010) all ocean disposal at the Morehead City ODMDS must be conducted in accordance with the applicable Ocean Dumping Regulations and Criteria found in 40 CFR Parts 220-238, whether conducted as a permit activity or as a federal activity. The following are Morehead City ODMDS management requirements and all permits or evaluation concurrence shall be conditioned to include these requirements.

Dredged Material Evaluation. Only dredged materials which have been evaluated in accordance with USEPA's Ocean Dumping Regulations and Criteria and found in compliance with those criteria will be transported for disposal in the Morehead City ODMDS (USEPA/USACE 2010). Guidance for evaluation of dredged materials under the MPRSA Section 103 program is provided in the Evaluation of Dredged Material Proposed for Ocean Disposal - Testing Manual, February 1991 and the Regional Implementation Manual, Requirements and Procedures for Evaluation of the Ocean Disposal of Dredged Materials in Southeastern Atlantic and Gulf Coastal Waters, 2008. The determination of dredged material suitability for ocean disposal must be documented in a MPRSA Section 103 evaluation and approved by USEPA Region 4 prior to disposal. Dredged materials will be reevaluated for suitability for ocean disposal in accordance with current USACE/USEPA guidance at an interval not to exceed three years. Reevaluation and testing procedures will be coordinated with the Wilmington District USACE and USEPA Region 4 before any sampling or testing is undertaken.

Dredged Material Suitable for Beneficial Uses. "Beneficial uses" refers to the concept that dredged material can be disposed in a way that is economically and environmentally acceptable and accrues environmental, economic or other benefits to society.

Coarse-grained dredged materials (sands) from the navigation channel should be disposed of on nearby beaches or within the littoral system when it is the least cost, engineeringly sound, environmentally acceptable option. Due to the large area of the ODMDS (8 square-miles), ODMDS dredged material capacity is not an issue and should not be for the foreseeable future. However, site capacity and mounding factors are favorably affected by not placing coarse-grained material in the ODMDS. Other beneficial uses of dredged materials are also encouraged pending appropriate environmental review.

As discussed previously, dredged material was excavated from the Morehead City ODMDS by Carteret County for sand replenishment of the Bogue Banks beaches in 2004 and 2007. Approximately 1.2 million cubic yards of historically placed Morehead City Harbor dredged material were removed from the northeast corner of the Morehead City ODMDS during those two events by hopper dredges and then pumped out onto the Bogue Banks beaches. This repository for dredged material provided good quality sand and facilitated access for the beach replenishment. When feasible, all coarse-grained material from the Morehead City Harbor channels will be placed in the Nearshore Placement Areas or on the beaches of Fort Macon, Atlantic Beach and Shackleford Banks. However, should circumstances ever warrant the disposal of coarse-grained material from the Harbor in the Morehead City ODMDS, disposal of those materials would be directed to a portion of the ODMDS or placement area where access and potential opportunities for recycling and beach nourishment are facilitated (Figure 1-5). Accordingly, the northern half of the Morehead City ODMDS is restricted to dredged material that is coarse-grained. Conversely, fine-grained materials may not be discharged there.

The sediment testing described in Appendix B confirmed the Harbor channel areas where fine-grained materials occur. Continued ocean disposal of these dredged materials is likely as other disposal/placement options, including beneficial uses, are either not available or not feasible. As discussed previously, only materials evaluated and found in compliance with the USEPA's Ocean Dumping Regulations and Criteria can be transported to the ocean for disposal. The Morehead City Harbor Navigation Channel sediments have been tested in accordance with USEPA regulations and criteria and dredged material from all reaches of the Harbor is acceptable for disposal in the ODMDS. In order to minimize interference with potential use of beach-quality sand for beach replenishment, the fine-grained sediments dredged from Morehead City Harbor navigation channel will be placed in the far southwest corner of the Morehead City ODMDS as shown on Figure 1-5. Fine-grained sediments that may be disposed of in the ODMDS would come from the Morehead City Inner Harbor or the Outer Entrance Channel.

Dredged Material With Debris. If significant quantities of debris (either wood or man-made) are present in the dredged materials, then debris management should be conducted. Significant quantities of debris are considered to be those which would materially interfere with fishing in areas near the Morehead City ODMDS or interfere with re-use of dredged material from within the ODMDS (i.e., beach nourishment borrow material). Debris management may involve the following:

- Removal of the debris from the dredged material before transportation to the ODMDS;
- Disposal of dredged material in the ODMDS in a location (e.g., farthest distance possible from the fishing areas or borrow areas) such that debris interference is unlikely;
- Immobilizing the debris within the ODMDS by covering it (capping) with dredged material.

Methods of Disposal. Disposal is typically accomplished by hopper dredge or dump scow. For each disposal project, a specific area within the ODMDS will be designated for use and a specific disposal pattern will be prescribed. Dredged materials will be discharged within the ODMDS boundaries. Dredged material disposal will not be allowed closer than 600 feet from the site boundary. The disposal of dredged materials outside the ODMDS boundaries is not acceptable under MPRSA authorities. An approved ocean disposal verification plan must be carried out. Disposal methods that minimize mounding of dredged material within the designated disposal area will be required.

Disposal Quantities. Quantities of dredged materials disposed of within the ODMDS will be limited to those amounts that do not produce unacceptable adverse effects to human health and welfare and the marine environment or human uses of that environment (as defined in USEPA's Ocean Dumping Regulations and Criteria). The disposal quantity management objective for the Morehead City ODMDS is to regulate disposal quantities such that depths in the disposal area following disposal do not interfere with navigation. The disposal depth limitation will be -30 feet mlw.. Current average depths in the ODMDS are approximately -45 to -50 feet mlw.

Timing of Disposal. There are no seasonal restrictions to the disposal of dredged material within the Morehead City ODMDS. However, seasonal restrictions and seasonal special requirements apply to particular dredging activities at particular locations. Refer to Section 2.1 for a discussion of dredging windows.

Channel Area. If the alignment of the Morehead City Harbor Range A channel is extended seaward, it crosses the eastern border of the ODMDS. In order to provide safe navigation, dredged material disposal will not be allowed within approximately 1000 feet of the current limits of channel dredging. This area where the navigation channel intersects the ODMDS is shown on Figure 1-5. Disposal of dredged material in this area will be allowed only after a review by Wilmington District USACE in consultation with USEPA Region 4 and only if a determination is made that the proposed disposal will specifically not interfere with navigation.

3.2.4 Ebb Tide Delta

To aid in the development of the DMMP, an analysis of changes within the Beaufort Inlet ebb shoal complex was completed. The results of the analysis will help determine placement quantities and locations of material dredged from the adjacent navigation channel. An understanding of potential impacts to the ebb tide delta is important because changes to the complex may eventually impact adjacent beaches.

3.2.4.1 Ebb and Nearshore Shoal Analysis

Bathymetric Data Collection. Bathymetric data were available from four different survey periods for the Beaufort Inlet complex; June 1974 National Oceanographic and Atmospheric Administration (NOAA) Survey, September 1998 NOAA Survey, a June 2005 survey provided by the Division of Coastal management through Geodynamics, LLC, and an April 2009 survey contracted through the USACE, Wilmington District. The reference datum used for the bathymetric comparison was the North American Vertical Datum of 1988 (Appendix E, Explanation of Vertical Datum). The use of this datum required conversion of the NOAA data from its mean low water reference datum to a reference datum of NAVD 88. After conversion, data from the 2005 North Carolina Division of Coastal Management (NCDCM) survey were observed to be deeper than corresponding data from the 2009 Beaufort Inlet survey in the offshore portion of the profile. Discussions with the surveyor revealed that the 2005 DCM survey data when collected was processed with an incorrect heave and speed of sound correction calculation within the software. The errors occurred during collection of the data and therefore a raw data file without errors was not available for processing. To compensate for these errors and keep the survey in the data set, a section of data in the offshore portion of the survey on the east side of the navigation channel was used to create an adjustment factor. Data difference in this area, beyond the depth of closure, were averaged and an adjustment of +0.95' was applied to the entire 2005 inlet survey. One additional NOAA survey from March of 1953 was excluded from the analysis due to what appeared to be a datum error associated with the survey in the offshore portion of the profile.

Bathymetric Changes. Coverage of the ebb tidal delta for Beaufort Inlet is shown in Figure 3-11 from the most recent survey of May 2009. From this survey, gross patterns of seafloor morphology are evident. These include the Ocean Dredged Material Disposal Site (ODMDS) in the southwest corner of the bathymetry, the nearshore placement area located west of the navigation channel approximately 1 mile offshore, the inlet ebb tide delta split by the Morehead City navigation channel, and a minor flood channel on the west side of Beaufort Inlet. Also visible in the photo is apparent scour in the east lobe of the ebb tide delta that appears to be caused by ebb currents attempting to re-align the channel from a north-northeast alignment to more of a north-northwest orientation. Further modeling of currents within the region is needed to confirm.

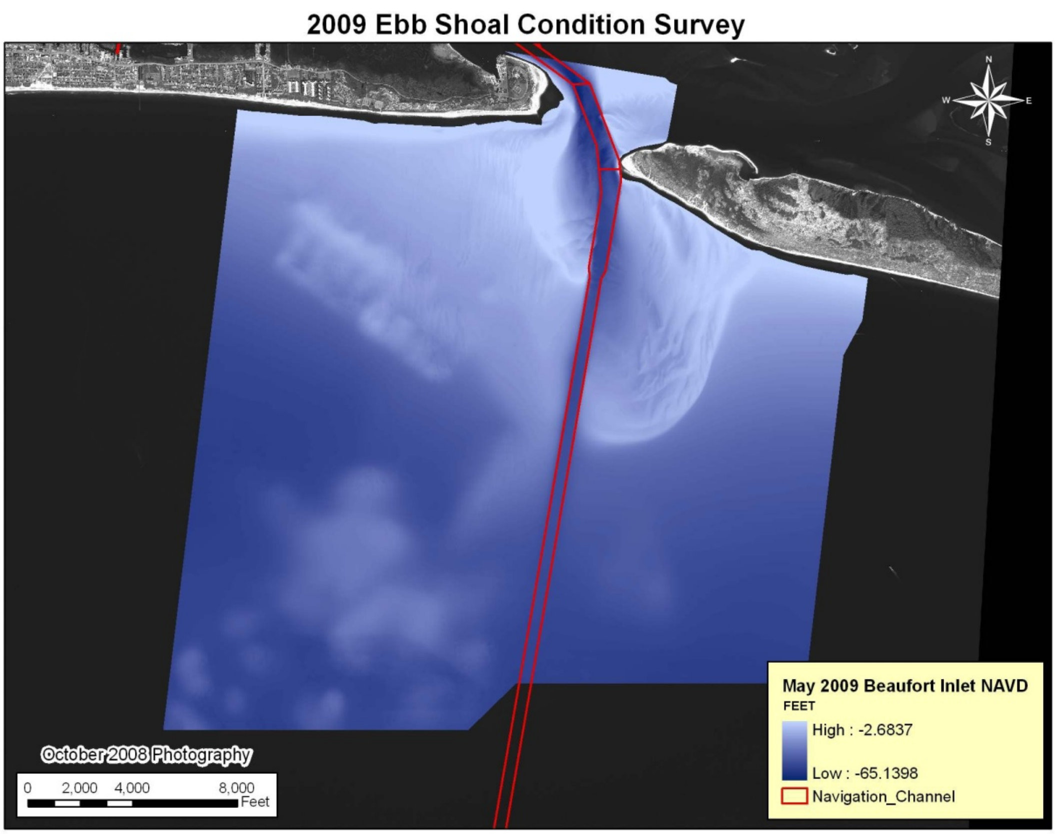


Figure 3-11. Current Ebb Shoal Conditions at Beaufort Inlet

Comparisons between surveys were made by generating maps showing changes in the bathymetry over time. These difference maps were contoured in 2 foot intervals with changes between -2 and 2 feet not displayed to improve visual clarity of the map. Figure 3-12 is a difference plot showing the differences in bathymetry from our earliest available inlet survey in June 1974 with the September 1998 survey. The majority of changes that occurred during our study period of 1974 to 2009 are shown in this difference plot. The plot indicates that extensive erosion occurred over a majority of both the east and west halves of the inlet ebb tide delta with the erosion in the west side of the delta ranging from 3 to 7 feet, while the erosion on the east side of the navigation channel ranged from 6 to 12 feet. There appeared to be four major exceptions to what occurred in the majority of the ebb tide delta region. The first was an erosional hot spot located just west of the northern most visible portion of the navigation channel. This area experienced extensive vertical erosion up to 38 feet. This could be the result of material sloughing off this point into the cutoff portion of the navigation channel which is dredged on a routine basis. Due to the regular dredging of the cutoff section which removes the foundation of this point, the bank is not able to stabilize and should continue to erode until an equilibrium slope is reached. The second exception to the general erosion of the ebb tide delta area is just east of the northern most visible portion of the navigation channel. This area has accreted as much as 16 feet. While difficult to know the cause of the accretion in this area it could be related to the erosion observed on the west side of the inlet with possible bypassing of sand past the navigation channel building up the shoal just off Shackleford Banks. To further investigate both of these areas, modeling of the system currents would be needed. The third exception to the general trends of the ebb tide delta is the obvious nearshore area located west of the navigation channel approximately 1 mile offshore. This area is discussed later in this report and examines in detail historic placement and sediment movement within the nearshore placement area. The last major exception is the shoaling that has occurred in the southern portion of the eastern half of the ebb tide delta. This area of the delta has shoaled up to 19 feet and has extended this half of the delta nearly 2000 feet seaward when compared to the 1974 survey. This appears to be related to the ebb currents attempting to straighten the navigation channel from its dredged orientation of north-northeast to more of a north-northwest orientation. This appears to be the predominant cause of the deflation of the eastern half of the ebb tide delta.

Figure 3-13 is a difference plot showing the changes between September 1998 and June 2005 that occurred within the same bounding area as in Figure 3-12. Most of the trends observed in the comparison of the 1974 to 1998 data continue into this time period. The eastern half of the ebb tide delta has continued to experience an overall deflation, however the western half seems to have stabilized with only a few areas showing erosion greater than 2 feet. The erosion hot spot located on the west side of the northern most visible portion of the navigation channel has continued to erode and even increased in area. The shoaling on the opposite side of the navigation channel from this erosional hot spot, while still occurring, has decreased and moved farther offshore from the point at Shackleford Banks. The nearshore placement area has increased in size due to continued placement of material farther south as placement cells fill with material. The final area seeing change is the southernmost portion of the eastern ebb delta. This area has continued to grow south, away from Shackleford Banks. The growth area observed between 1974 and 1998 actually eroded up to 7 feet during the time period of 1998-2005, which indicates that the currents are continuing to push material over the eastern shoal in an attempt to straighten the navigation channel.

Figure 3-14 displays the bathymetric change that occurred during the period of June 2005 through April 2009. The same trends established during previous analysis periods continue into this most recent time period, although to a lesser extent. The western lobe of the ebb tide delta appears relatively stable with significant change occurring only in the offshore portion of the nearshore placement area. The inlet throat continues its erosive pattern into this period with the area of erosion continuing to expand. The eastern lobe of the ebb tide delta shows continued erosion throughout the majority of the area with accretion at the offshore edge of the analysis area. This remains consistent with trends previously observed, however the accretion in the offshore area is lower in both magnitude and area. Figure 3-15 shows the cumulative changes previously discussed for the time period 1974 to 2009. The figure clearly shows the extensive areas within the ebb tide delta which have eroded. Also visible in the figure are the areas of accelerated erosion and accretion occurring near the inlet throat, the gains in the nearshore placement area, and the accretion and expansion of the offshore portion of the east ebb tide delta.

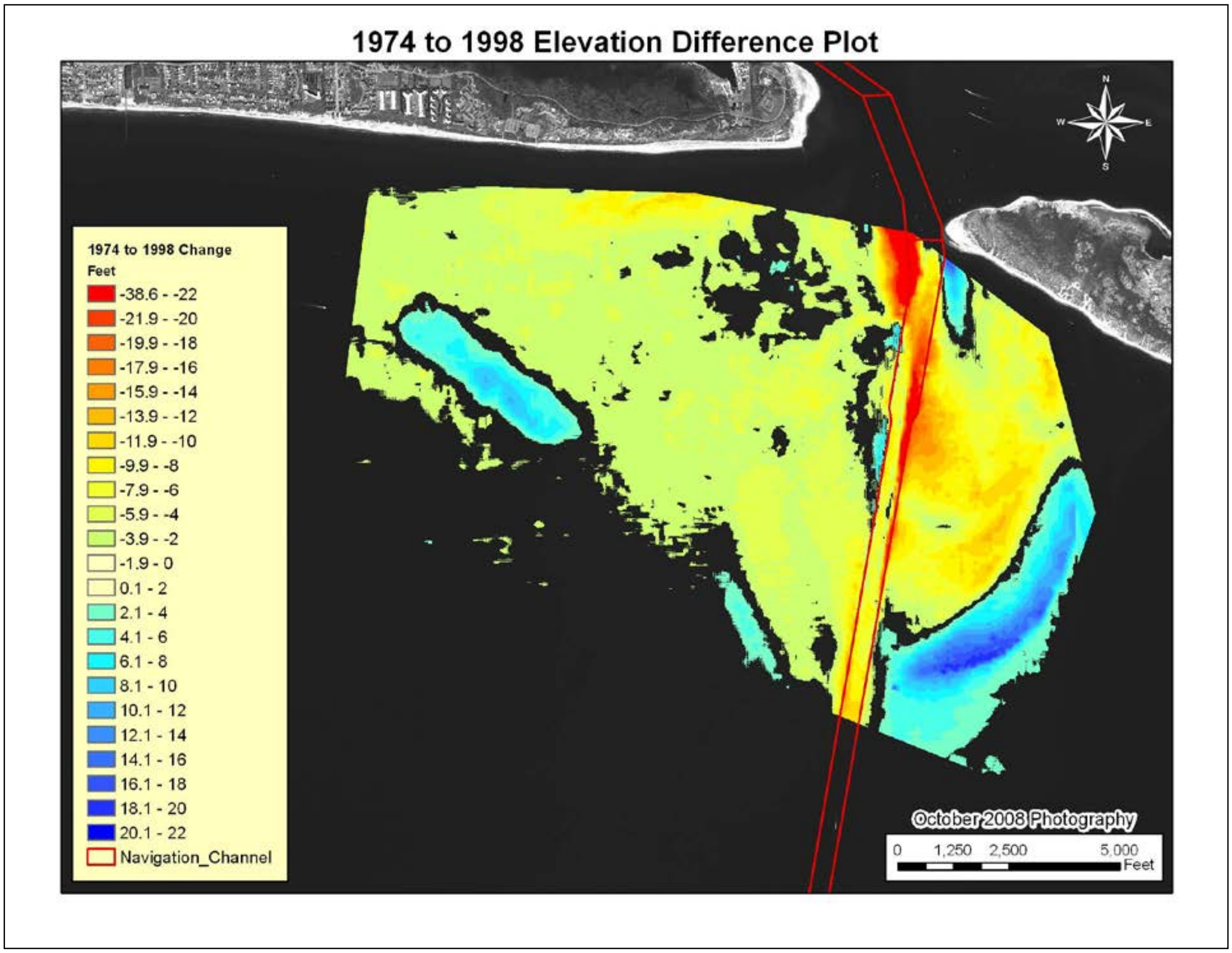


Figure 3-12. Bathymetric Changes, 1974 to 1998

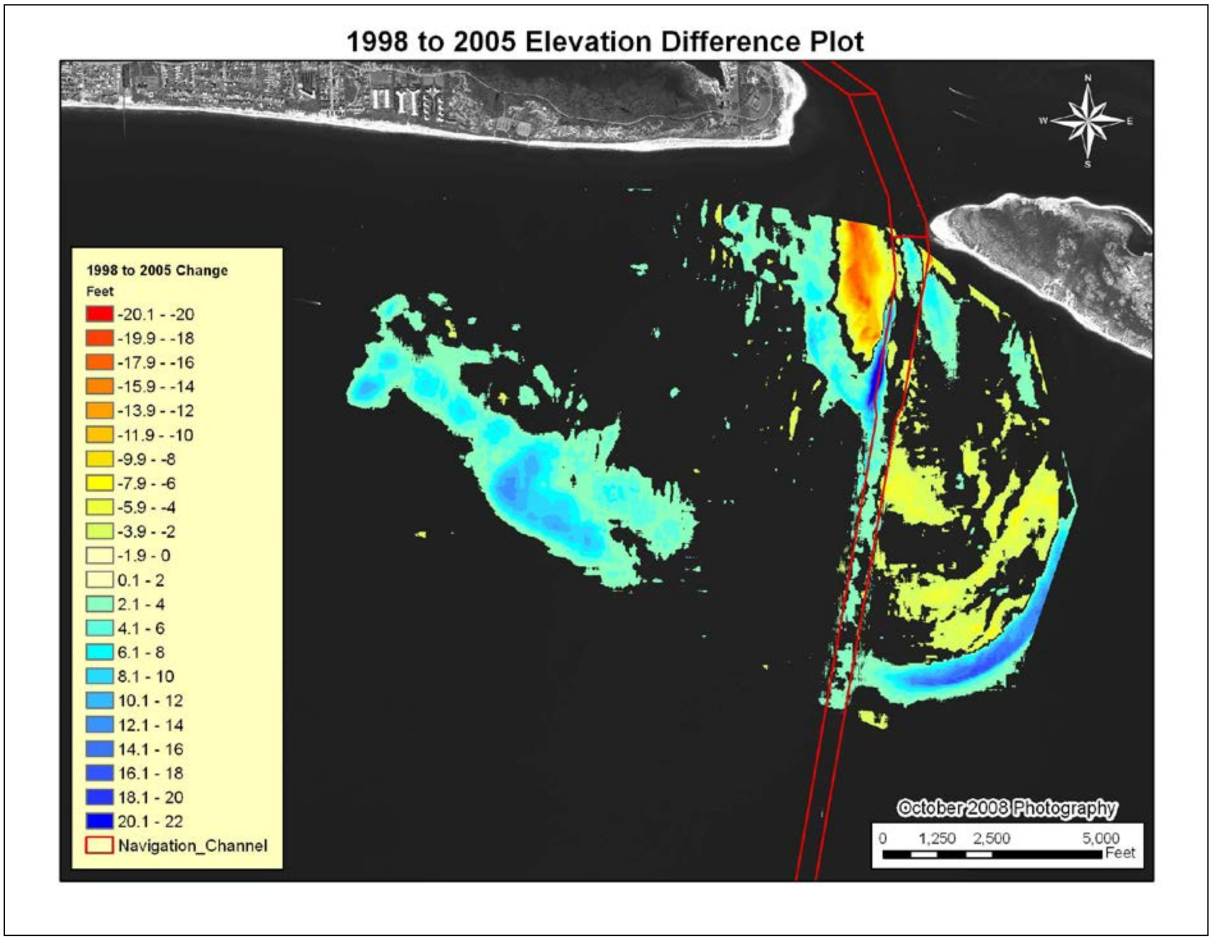


Figure 3-13. Bathymetric Changes, 1998 to 2005

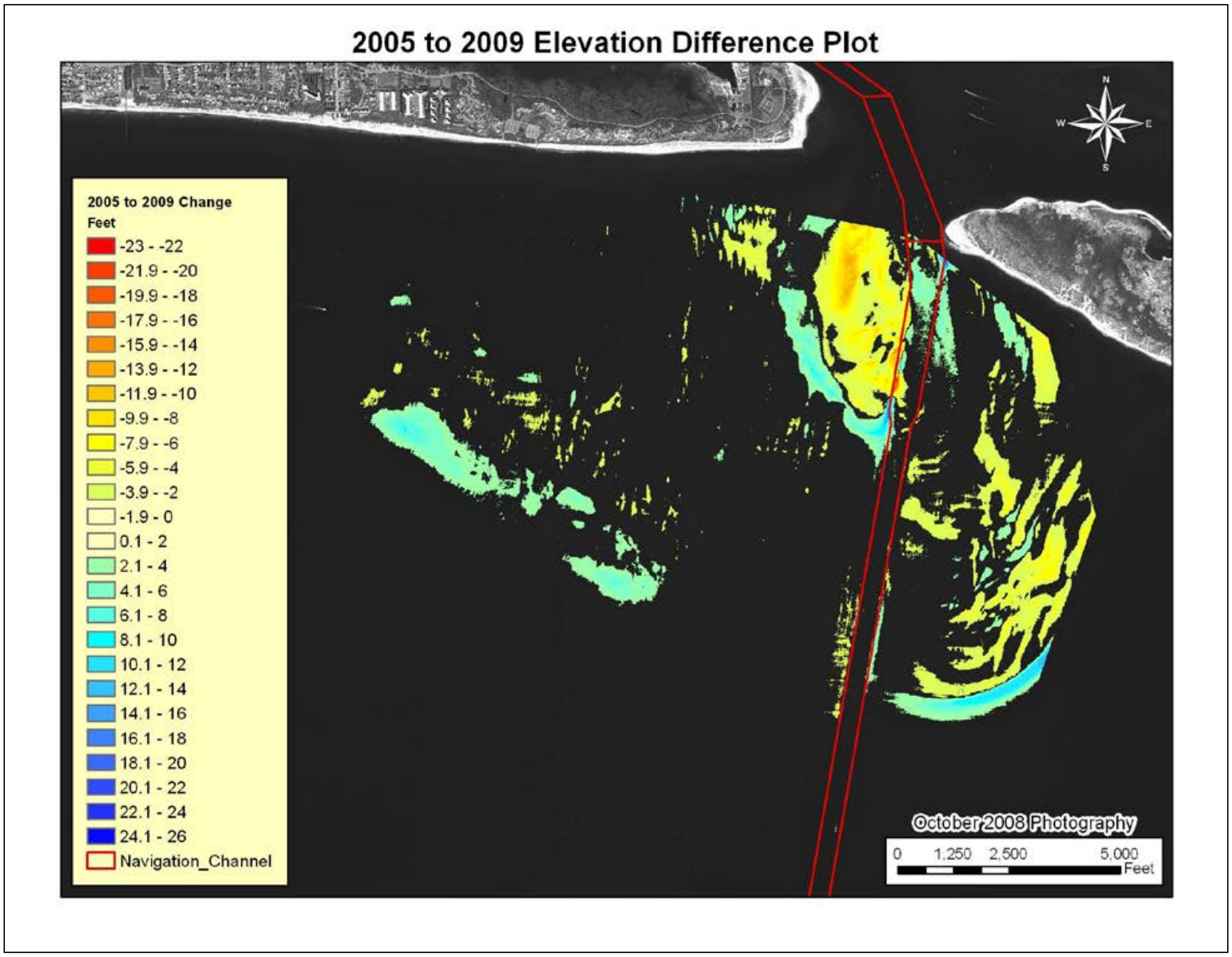


Figure 3-14. Bathymetric Changes, 2005 to 2009

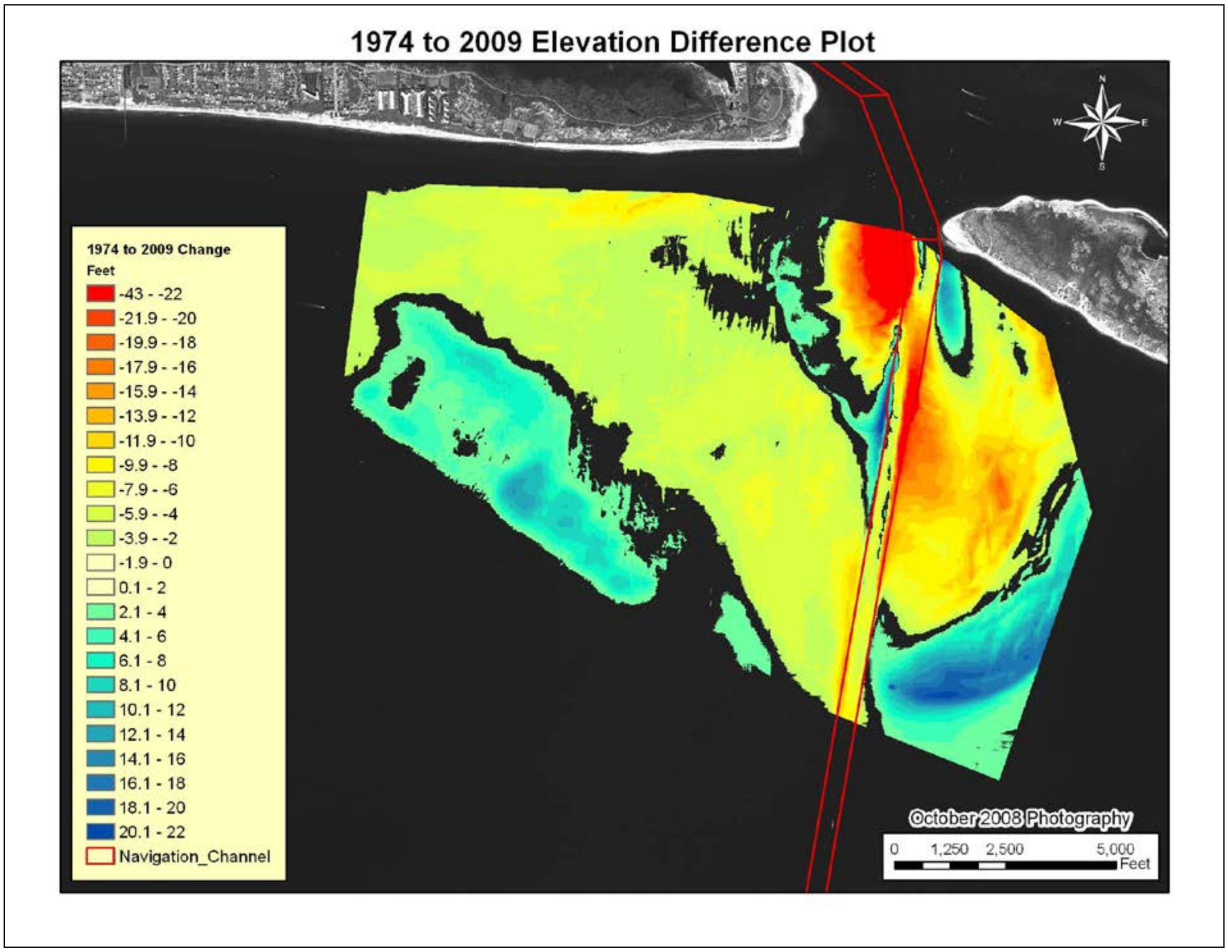


Figure 3-15. Bathymetric Changes, 1974 to 2009

Volumetric Analysis. In order to quantify the changes occurring within the inlet complex, a comparison of volumetric change over the different time periods of the available surveys was performed. The analysis included separating the inlet into six areas in an attempt to separate predominantly eroding and accreting areas as well as isolate the anomalous areas discussed in the Bathymetric Change section of this report. Figures 3-16 through 3-21 show the six areas analyzed and volumetric changes are summarized in Table 3-4 and Table 3-5. The analysis was conducted over four time periods; from 1974 to 1998, 1998 to 2005, 2005 to 2009, and 1974 to 2009. This was done to compute change rates over different time periods which could help determine if changes were increasing, decreasing, or relatively consistent within each region. Change rates for these periods are summarized in Table 3-6.

Figure 3-16 shows the analysis area for the east ebb tide delta located just off the point of the western end of Shackleford Banks. This area was mentioned earlier as having signs of accretion in an otherwise eroding portion of the ebb tide delta. Within the figure, the accreting area is clearly visible in blue surrounded by areas of erosion. While this center section is accreting, the area as a whole has eroded nearly 480,000 cubic yards since 1974 which translates to an average deflation of 2.9 feet for this area. Looking further into the different time periods analyzed shows that the majority of change within this region occurred in the first time period, 1974 to 1998, while the two subsequent time periods showed accretion in the area as a whole. The change rate for this region over the entire analysis period of 35 years was approximately -13,700 cubic yards per year.

Figure 3-17 shows the middle section of the east ebb tide delta. This area has experienced considerable erosion when compared to our base year survey. Total erosion for the entire study period amounts to a loss of nearly 7,445,000 cubic yards of material. This loss of material results in an average deflation of nearly 9.2 feet over the entire area. Examining the different time periods shows that the erosion has been fairly consistent over all time periods with the average loss rate being approximately 234,000 cubic yards per year from 1974 to 1998, approximately -146,000 cubic yards per year from 1998 to 2005, and nearly 202,000 cubic yards per year for the period 2005 to 2009. The overall erosion rate covering the entire time period is approximately 213,000 cubic yards per year.

The offshore portion of the east ebb tide delta is shown in Figure 3-18. Study of this area shows that it has accreted significantly since the 1974 survey was taken, with a total increase of material being approximately 3,977,000 cubic yards. This amount of material averaged across the entire area shown in Figure 3-17 translates to an elevation increase of the seafloor of nearly 7.7 feet. As discussed earlier in this report, the changes appear to be related to the channel attempting to re-orient from a north-northeast configuration to more of a north-northwest orientation. This shift appears to be increasing current flow over the middle portion of the east ebb tide delta resulting in the losses shown in Figure 3-17. As this flow enters the offshore portion of the ebb tide delta, current velocities drop, resulting in a portion of the material lost from the middle section of the east ebb tide delta being deposited in the region covered by Figure 3-18. Examination of the first two time periods, 1974 to 1998 and 1998 to 2005, shows the accretion rate to be substantial in both; however, it appears to be decreasing in magnitude. The third time period from 2005 to 2009 indicates the area has begun to erode overall with an erosion rate of nearly 29,000 cubic yards per year over this time period. This is partly due to the continued migration of material into deeper areas offshore. These areas are outside of the survey coverage available and quantities for comparison are not available. The overall accretion rate for the region was approximately 114,000 cubic yards per year measured from 1974 to 2009.

Figure 3-19 displays the analysis area for the west ebb tide delta throat area. This area has experienced the most erosion relative to its size of any of the areas within the ebb tide delta. The area has eroded nearly 3,751,000 cubic yards since 1974 resulting in an average deflation of nearly 16 feet. Review of the volumetric change rates for the 1974 to 1998, 1998 to 2005, and 2005 to 2009 time periods shows the loss rate per year increasing with time. The average loss rate for the region over the entire study period was found to be approximately 107,000 cubic yards per year. As discussed earlier in this report, the excessive loss rate in this area is more than likely due to material moving into the adjacent navigation channel which is dredged on a routine basis as part of the Morehead City Harbor Navigation project.

The majority of the west ebb tide delta area is shown in Figure 3-20. This area has lost almost 7,877,000 cubic yards of material since the 1974 survey. This amount of material averaged over the represented area translates to an average deflation of nearly 3.4 feet. Volumetric change rates have varied greatly over the different time periods within this area. This area lost approximately 322,500 cubic yards of material per year on average from 1974 to 1998. The following time period, 1998 to 2005, the area actually accreted nearly 173,200 cubic yards per year. This was most likely due to deposition of material within the nearshore area migrating into the west ebb tide delta, as well as, material eroding from the western throat into the northeast corner of the ebb tide delta. The most recent period from 2005 to 2009 showed that the area again became erosive and lost material at an average rate of 323,800 cubic yards per year. The average loss rate per year over the study time frame of 1974 to 2009 was nearly 225,600 cubic yards per year.

The final area of the ebb tide delta included in our analysis was that of the nearshore placement area. Figure 3-21 shows the analysis area for this section of the report covering the nearshore placement area. A subsequent section of this report provides more in-depth analysis of the nearshore placement area confined only to the areas of placement and includes many more survey dates. The analysis in this section of the report is included only to provide a similar comparison of this area over the same survey dates used in the analysis of the remainder of the ebb tide delta. This analysis showed that the nearshore placement area represented in Figure 3-21 gained nearly 3,544,000 cubic yards of material since 1974, is an average gain of approximately 2.1 feet in seafloor elevation over the analysis area. This material gain is due primarily to the placement of beach quality material dredged from the Morehead City Harbor Navigation Channel. Analysis of the 1974 to 1998 survey comparisons showed the area to be eroding nearly 16,600 cubic yards per year while the 1998 to 2005 comparison showed the influence of the dredged material placement with the rate accreting at approximately 521,000 cubic yards per year. During the most recent time period, 2005 to 2009, the accretion rate slowed to just less than 99,000 cubic yards per year. Overall accretion rate for the entire study period is just over 101,000 cubic yards per year.

In conclusion, the ebb tide delta complex as a whole has experienced substantial erosion of approximately 12 million cubic yards since 1974. Without the quantities of material placed in the existing Nearshore West placement area (~6.2 million cubic yards), the total deflation would have been approximately 18.2 million cubic yards. This quantity is split between the two lobes of the ebb tide delta with 78% lost from the west and 22% lost from the east. The major exceptions to the general trend of deflation are in the offshore portion of the eastern ebb delta and the nearshore placement area on the western ebb delta for the reasons detailed earlier in this section. An understanding of coastal inlet processes suggests that continued erosion of the ebb tide delta complex is likely to impact the adjacent beaches. The mechanisms of ebb tide delta deflation that would lead to impacts to the adjacent beaches include: (1) increased wave heights and changes to their approach angles as a result of changes in the offshore wave transformation, which would result in increased shoreline erosion and volumetric losses of sand along the beach; (2) changes in longshore transport rates and flow paths of sediment would also be expected; and (3) changes would be expected in the shoaling rates within the channel. The locations, severity and timing of the impact are unknown at this time. It is likely that any impact to the shoreline along Bogue Banks up to this point has been mitigated by previous disposal of federal navigation maintenance material along the eastern end of the island as indicated in the Section 111 report; however, continued deflation of the ebb tide delta may eventually overtake those efforts.

Every practical and sound effort, including reasonable use of light-loaded vessels or eliminating the option of disposal in the ODMDS from dredging contracts, will be considered to retain littoral material dredged from the navigation channels within the inlet complex to minimize this ebb tide delta deflation. A comprehensive monitoring program, as outlined in Appendix F (Morehead City Harbor Monitoring Plan), will provide data to assess ongoing operations and its impacts.

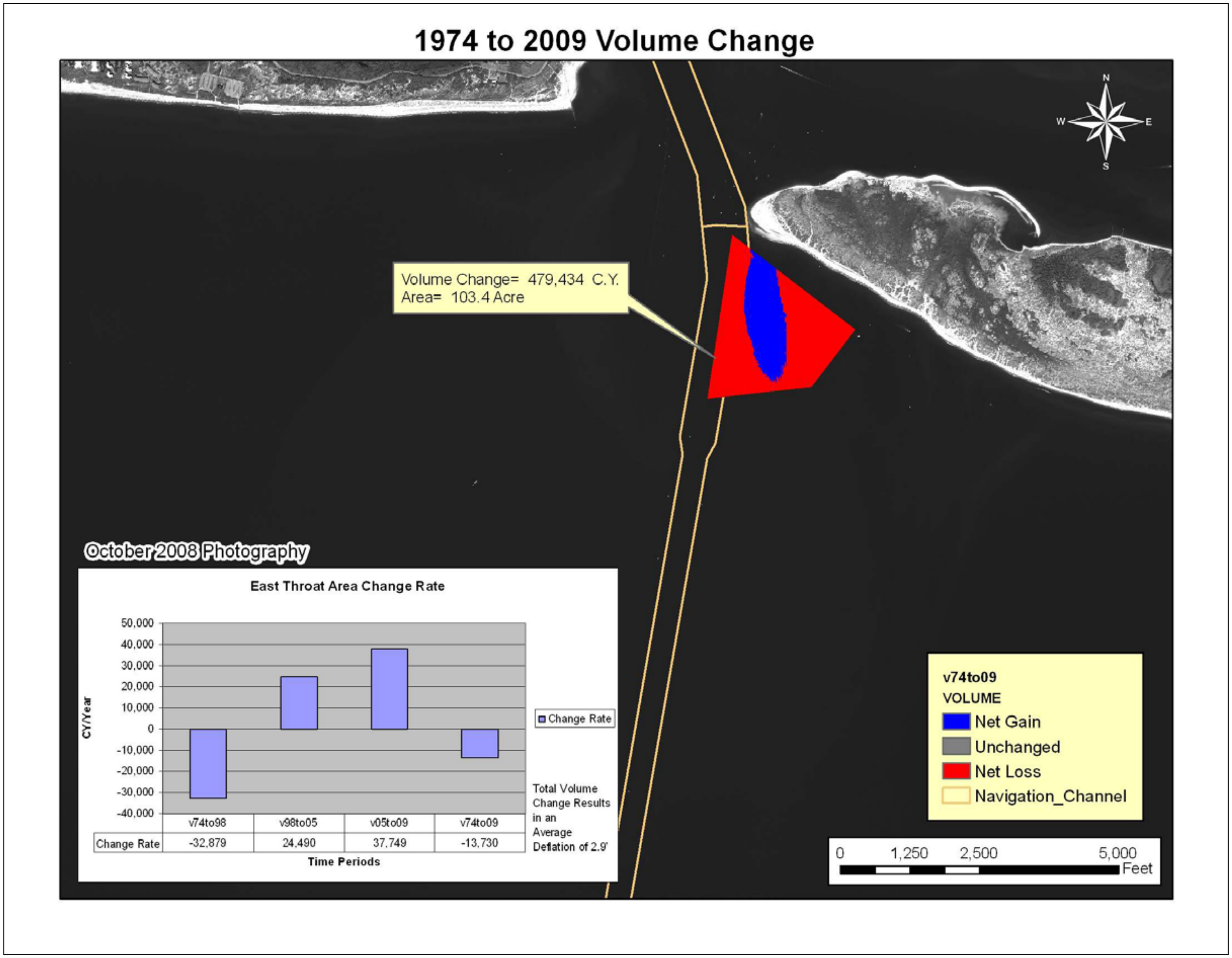


Figure 3-16. East Throat Area Volumetric Change

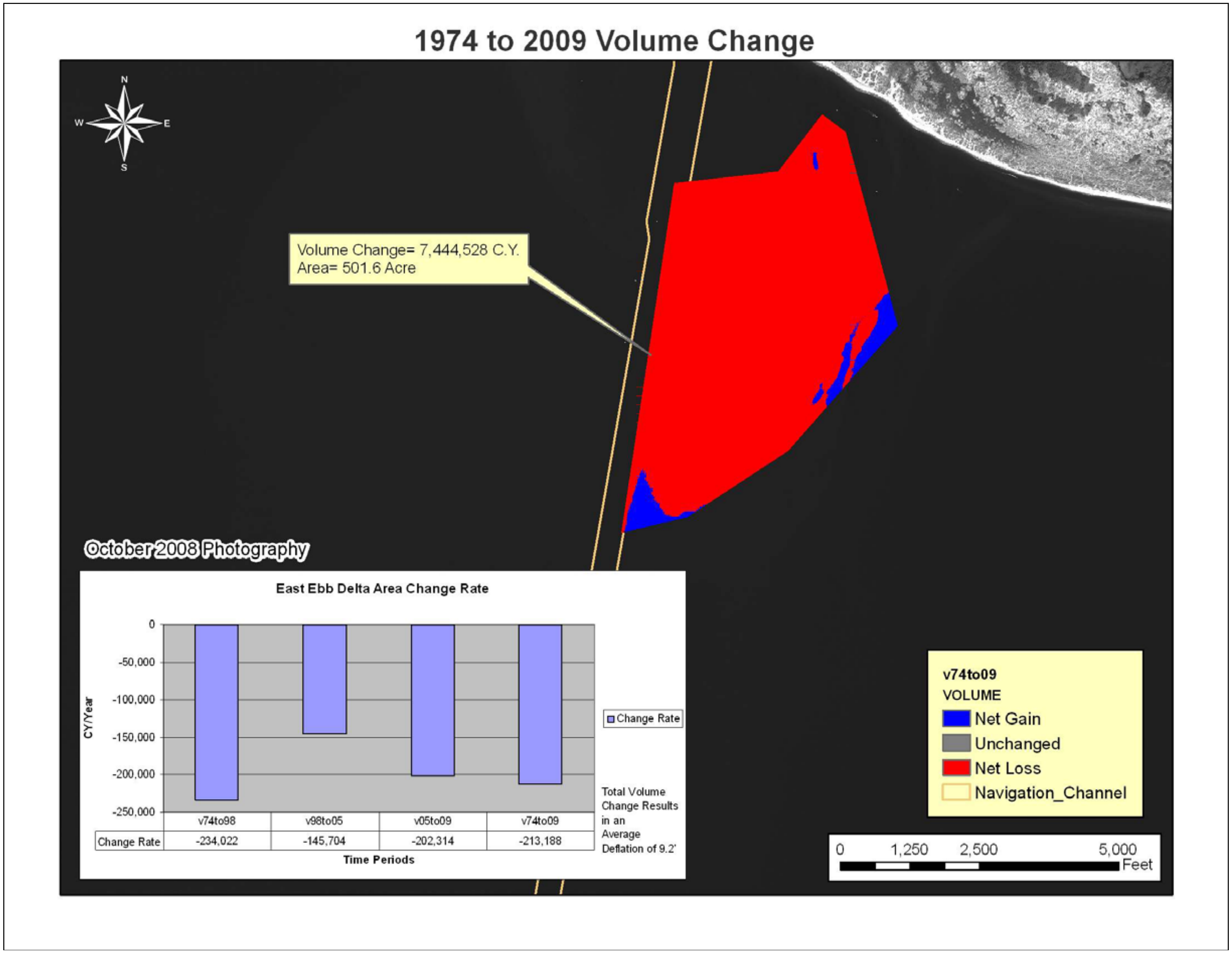


Figure 3-17. East Ebb Delta Volumetric Change

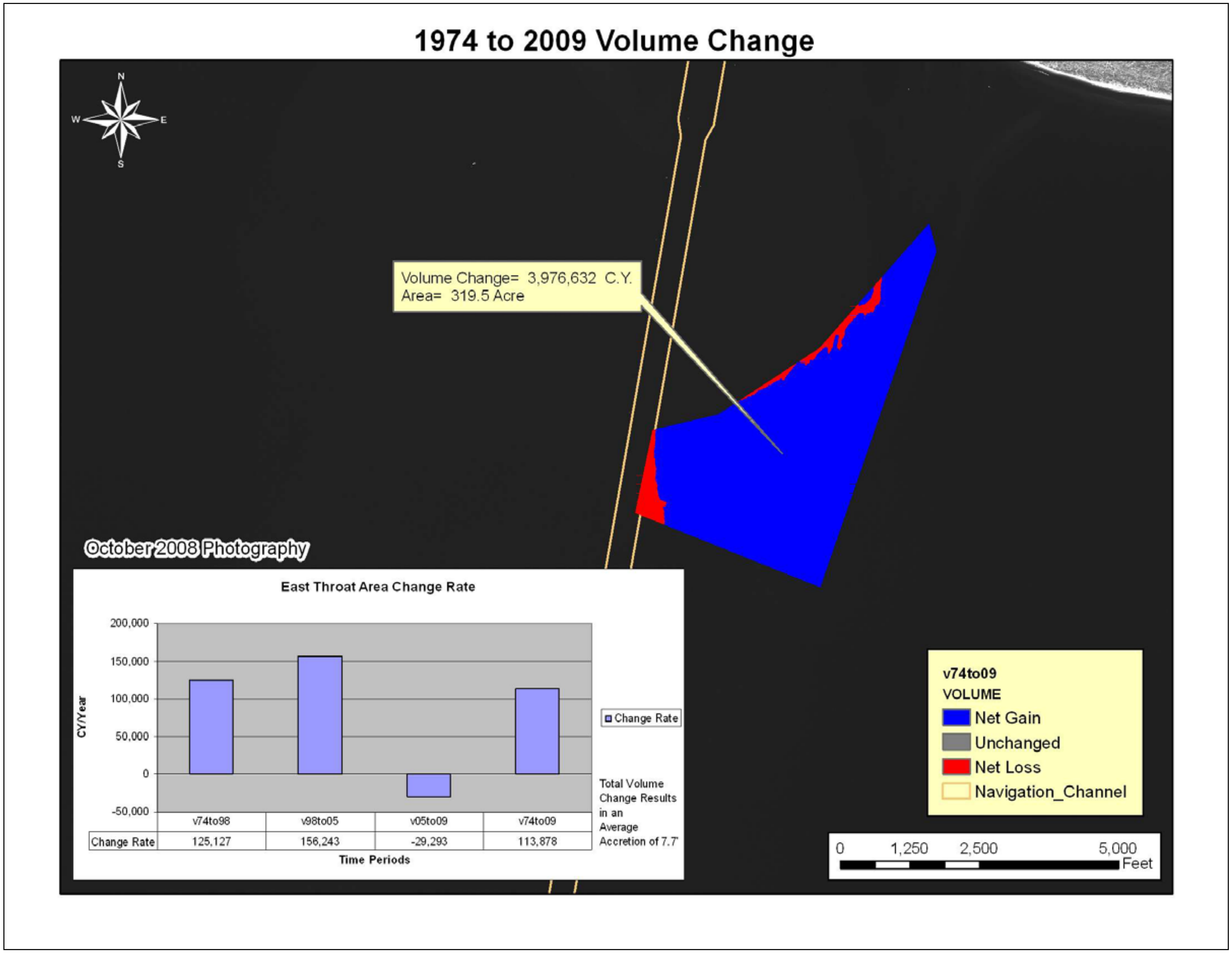


Figure 3-18. East Offshore Delta Area Volumetric Change

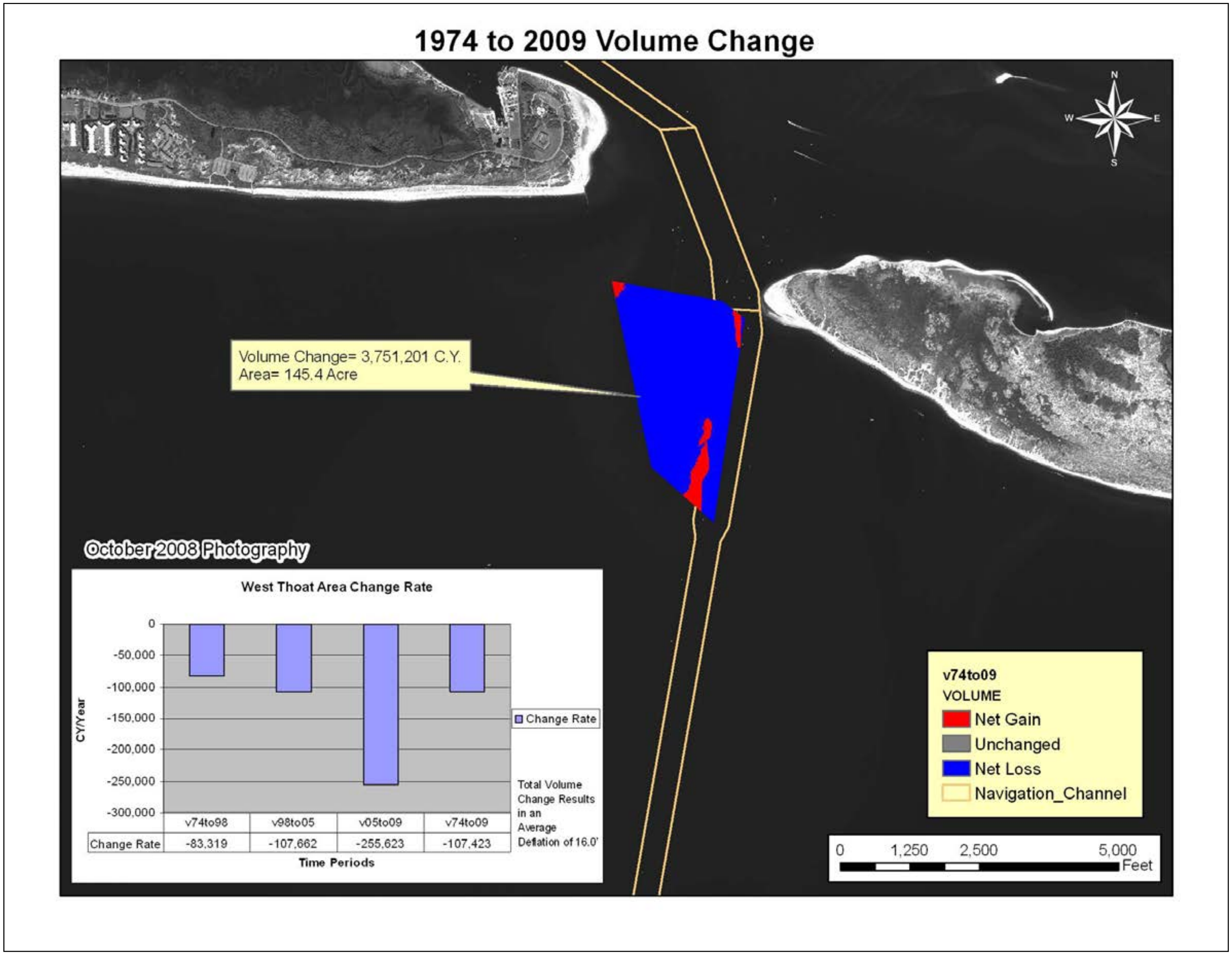
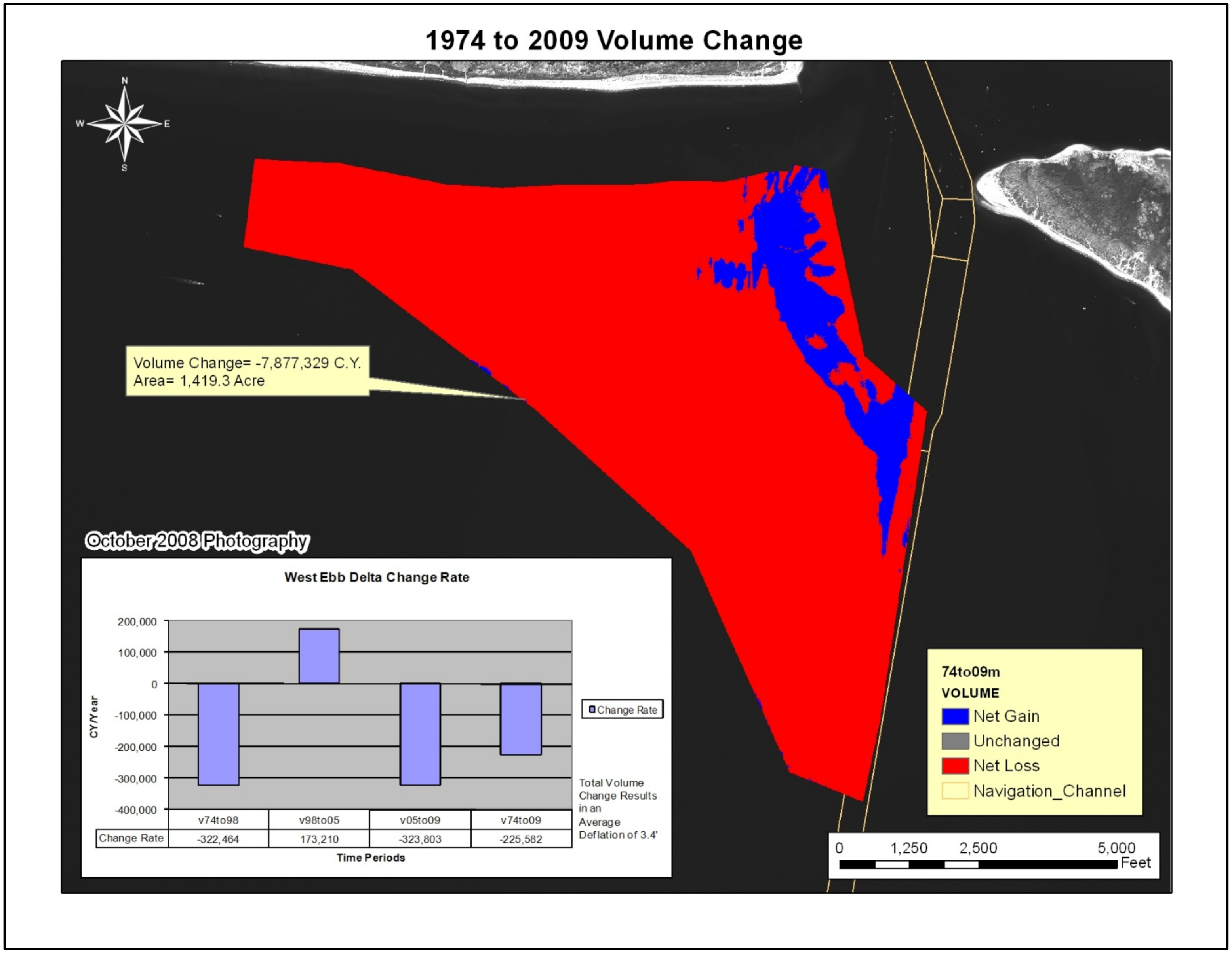
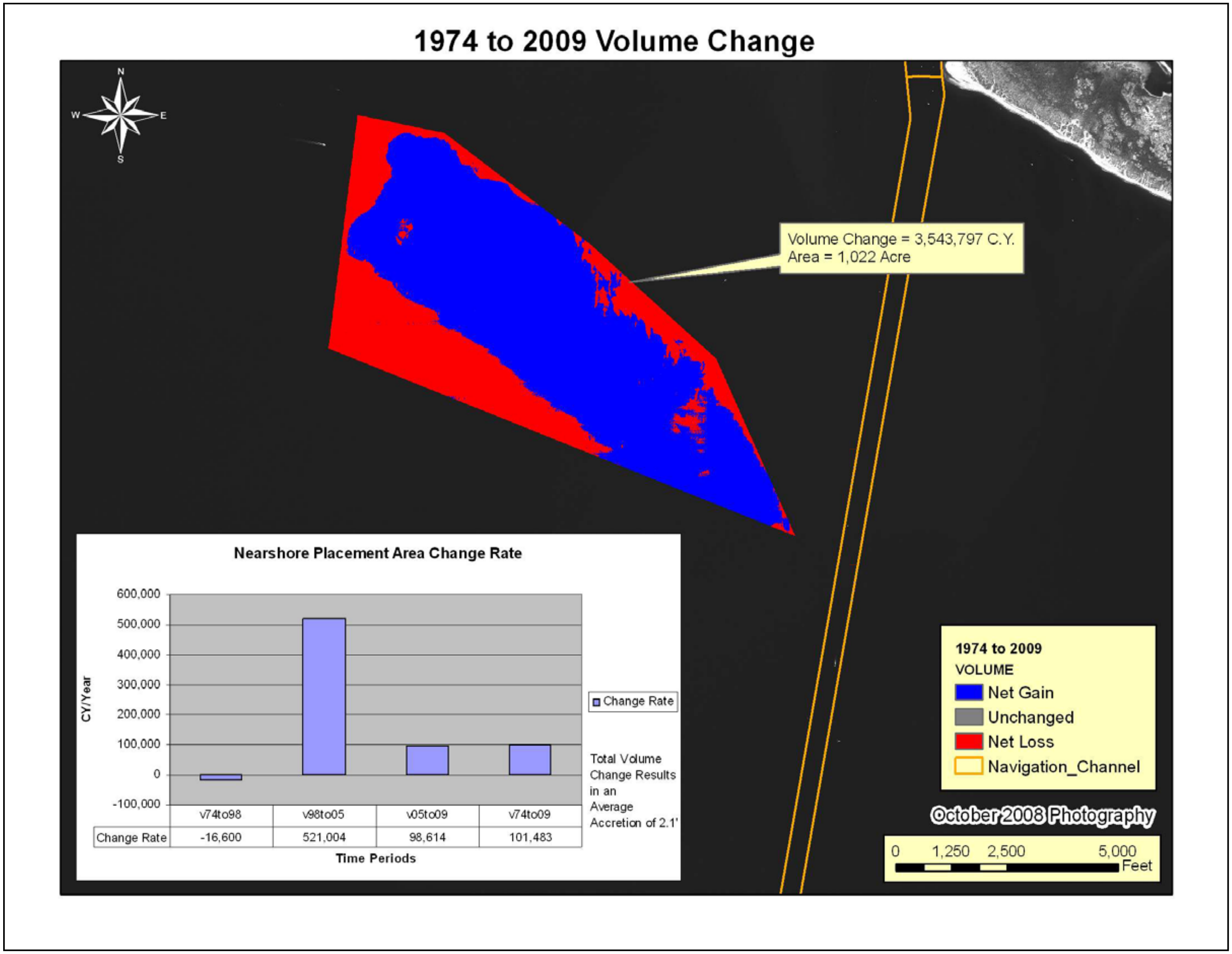


Figure 3-19. West Throat Area Volumetric Change



	v74to98	v98to05	v05to09	v74to09
Change Rate	-322,464	173,210	-323,803	-225,582

Figure 3-20. West Ebb Delta Volumetric Change



	v74to98	v98to05	v05to09	v74to09
Change Rate	-16,600	521,004	98,614	101,483

Figure 3-21. Nearshore Placement Area Volumetric Change

Location	Area (Square Feet)	Volume Change 1974-2009 (Cubic Yards)	Average Vertical Change (Feet)
East Throat Area	4,502,995	-479,434	-2.9
East Ebb Delta	21,848,459	-7,444,528	-9.2
East Offshore Delta	13,916,629	3,976,632	7.7
West Throat Area	6,334,870	-3,751,201	-16.0
West Ebb Delta	61,824,956	-7,877,329	-3.4
Nearshore Disposal Area	44,529,776	3,543,797	2.1
Total	152,957,683	-12,032,063	

Table 3-4. Volumetric Change and Vertical Shift

Location	Volume Change 1974-1998 (Cubic Yards)	Volume Change 1998-2005 (Cubic Yards)	Volume Change 2005-2009 (Cubic Yards)	Volume Change 1974-2009 (Cubic Yards)
East Throat Area	-794,678	167,269	147,975	-479,434
East Ebb Delta	-5,656,301	-995,155	-793,071	-7,444,528
East Offshore Delta	3,024,319	1,067,141	-114,829	3,976,632
West Throat Area	-2,013,831	-735,329	-1,002,041	-3,751,201
West Ebb Delta	-7,793,949	1,183,024	-1,269,308	-7,877,329
Nearshore Disposal Area	-401,227	3,558,459	386,566	3,543,797
Total	-13,635,667	4,245,409	-2,644,709	-12,032,063

Table 3-5. Volumetric Change Summary

Location	Volumetric Change Rate 1974-1998 (Cubic Yards/Year)	Volumetric Change Rate 1998-2005 (Cubic Yards/Year)	Volumetric Change Rate 2005-2009 (Cubic Yards/Year)	Volumetric Change Rate 1974-2009 (Cubic Yards/Year)
East Throat Area	-32,879	24,490	37,749	-13,730
East Ebb Delta	-234,022	-145,704	-202,314	-213,188
East Offshore Delta	125,127	156,243	-29,293	113,878
West Throat Area	-83,319	-107,662	-255,623	-107,423
West Ebb Delta	-322,464	173,210	-323,803	-225,582
Nearshore Disposal Area	-16,600	521,004	98,614	101,483

Table 3-6. Volumetric Change Rate Summary

3.2.4.2 Ebb Tide Delta Placement

In an effort to retain the material dredged from the navigation channel within the littoral system, a nearshore placement area was established in 1995 on the west side of the navigation channel within the Beaufort Inlet ebb shoal (Nearshore West). The existing nearshore placement area is shown in Figure 3-22 and is located approximately between 0.65 and 2.0 miles from the shoreline of Fort Macon State Park centered on the 25-foot mean low water (mlw) contour. The currently authorized nearshore placement area covers approximately 559 acres of sea floor and the area is currently functioning as a placement location for coarse-grained sand exclusively (sand content greater than or equal to 90%). The DMMP proposes to modify this practice by allowing dredged materials greater than or equal to 80% sand to be placed in the nearshore placement areas.

Dredging records indicate a total of nearly 6,200,000 cubic yards of material was placed within the Nearshore West area between 1995 and 2006 (Table 3-7). Average placement into the Nearshore West placement area is approximately 550,000 cubic yards per year for the referenced time period. This annual quantity placed within the nearshore environment exceeds the rate loss of the ebb tide delta as discussed earlier in this report. When the 6.2 million cubic yards placed into the west ebb tide delta since 1974 is factored into the losses in Table 3-6 (Volumetric Change Rate Summary), it is shown that this area lost nearly 14,266,000 cubic yards, or 408,500 cubic yards per year through 2009. Including the 6.2 million yards of material placed in the deflation calculation is conservative in that the placed material may have eroded at a faster rate than the natural delta. However, given the limited number of surveys of the ebb tide delta it is not possible to accurately segregate out this material and independently measure its influence on the deflation rate. Continued placement within the western nearshore environment of dredged material should serve to reduce or ameliorate the overall deflation impacts related to the dredging of the navigation channel. However, deflation rates of the ebb delta will vary annually based, in part, on the amount of material disposed of offshore due to weather conditions during dredging events.

Analysis of bathymetric surveys indicate that material placed within the existing nearshore area is being retained within the littoral system and portions of the material are moving landward, reducing the rate of deflation of the western lobe of the ebb tide delta. The analysis of the nearshore zone surveys also indicates that material placed in smaller lifts into shallower locations will diffuse more rapidly to the surrounding ebb tide delta. One isolated placement occurred in the vicinity of the Queen Anne's Revenge Shipwreck (QAR) (Figure 3-22) in which nearly 41,000 cubic yards of material were placed with adequate pre- and post-construction surveys to monitor material evolution. Monitoring surveys of this area showed that the material diffused from the original location in a northeasterly direction and mound height decreased 6 feet over a period of 19 months. Based on these observations and in an effort to facilitate the diffusion of placed material toward the ebb tide delta, it is proposed that the existing Nearshore West placement area be modified to extend farther landward, approximately to the -17

NAVD88 contour. Every reasonable effort, including reasonable use of light-loaded vessels, will be made to place nearshore material in depths less than -25 feet MLW (-27.3 NAVD) to facilitate diffusion and retain material within the littoral system. This -25 MLW depth contour limit is based on changes observed in the existing nearshore environment when comparing historic surveys of placement within the area, as well as an analysis of sediment movement within the nearshore environment contained in the 1992 USACE Design Memorandum and Environmental Assessment for Morehead City Harbor (USACE 1992). These comparisons showed that material placed in shallower depths up to -25 feet MLW diffused landward, nourishing the ebb tide delta. Material placed in depths beyond -25 feet mlw does not diffuse landward at a substantial rate, except as driven by storms or other similar events. Material placed in deeper contours, however, could be beneficial to the ebb tide delta by stabilizing the offshore contours. In addition, the comparison of surveys showed no indication that material placed within the existing nearshore placement area diffused offshore. These surveys indicate that this material has remained in the ebb tide delta system. Figure 3-22 displays the proposed expanded area for the nearshore placement area. This proposed expansion covers 1,209 acres and expands the total placement area on the western side of the navigation channel to 1,768 acres total.

All material placed in the nearshore placement area is derived from maintenance of the Morehead city Harbor navigation project. Amounts placed are dependent upon available funding and navigation priorities.

Figure 3-22. Existing and Expanded Nearshore West Placement Area

CALENDAR YEAR	NUMBER OF HOPPER LOADS (% OF TOTAL)					ESTIMATED VOLUME (CU YDS)*				
	ODMDS		NEARSHORE		TOTAL	ODMDS		NEARSHORE		TOTAL
1995	193	79%	51	21%	244	635,709	79%	172,472	21%	808,181
1996	0	0%	328	100%	328	0	0%	656,646	100%	656,646
1997	476	62%	296	38%	772	1,143,400	59%	781,700	41%	1,925,100
1998a	209	41%	295	59%	505	270,400	27%	725,600	73%	996,000
1998b	161	100%	0	0%	262	209,990	100%	0	0%	209,990
1999	391	65%	208	35%	599	759,330	64%	425,760	36%	1,185,090
2000	98	17%	475	83%	573	149,595	16%	786,115	84%	935,710
2001	259	100%	0	0%	259	718,655	100%	0	0%	718,655
2002	0	0%	175	100%	175	0	0%	560,313	100%	560,313
2003	111	25%	337	75%	448	282,994	25%	858,298	75%	1,141,292
2004	--	--	--	--	--	--	--	--	--	--
2005	24	23%	81	77%	105	63,236	22%	220,419	78%	283,655
2006	147	33%	305	67%	452	468,958	32%	993,926	68%	1,462,884
TOTAL	2069	44%	2551	54%	4722	4,702,267	43%	6,181,249	57%	10,883,516

Note: * Estimated volumes are derived from vessel dump records provided by dredging contractor for ocean placement verification.
They are not based on channel surveys or contract pay yardages.
Prior to 1999, the volumes were computed using an average load volume for the hopper rather than a reported specific load volume.

Table 3-7. Nearshore Placement Quantities – 1995-2006

The analysis of bathymetric surveys from 1974, 1998, 2005, and 2009 indicate that both the east and west lobes of the ebb tide delta at Beaufort Inlet have experienced substantial deflation. To date, material has been exclusively placed on the western lobe of the ebb tide delta to reduce delta deflation and retain material within the littoral flow. The results found earlier in the volumetric analysis section show that the eastern ebb tide delta has lost approximately 3,947,000 cubic yards of material. This is an average annual loss of approximately 113,000 cubic yards per year. In order to reduce further deflation of the eastern ebb tide delta, a new nearshore placement zone is proposed on the east side of Beaufort Inlet as part of this DMMP. The quantity of material to be placed in this new nearshore area over the three year cycle of the proposed DMMP is expected to be the equivalent of the historic loss rate for the area over the three year cycle which is 339,000 cubic yards of sand (113,000 cy per year). However, this target quantity will be evaluated through the monitoring program and will be adjusted to conform to the evolving conditions of the east ebb tide delta. Additionally, quantities placed are subject to navigation priorities and the availability of dredging funds, which may not be sufficient to place quantities equivalent to the historic loss rate. Therefore, material placed within the ebb tide delta will be split between the western and eastern lobes based on the 78/22 ratio discussed earlier in this report within the Volumetric Analysis portion of the Ebb and Nearshore Shoal Analysis section. Figure 3-23 displays the proposed location of the new placement area (Nearshore East), which is located approximately 0.25 miles seaward of the Shackleford Banks shoreline and outside the Cape Lookout National Seashore (CALO) boundary. The NPS CALO boundary ends at the mean low water contour along the Atlantic ocean shoreline. The area covers approximately from the -17 ft NAVD88 contour to depths of -36 to -40 feet NAVD88 and is approximately 13,300 feet in length. In total, the proposed placement site covers an area of approximately 1.71 square miles (1,094 acres).

The new proposed region for this nearshore placement area is entirely within the westerly transport region of Shackleford Banks as established in the USACE Section 111 report, (USACE 2001). The net flow within this region of Shackleford Banks is westerly, toward the Inlet. Material placed within this area should move toward the west and nourish the eastern side of the ebb tide delta.

As shown in Figure 3-24, dredged material that may be placed within the Nearshore West and East comes from two portions of the navigation project:

1) The first is a portion of the Inner Harbor where material has typically been found to contain less than 90% sand. This material has historically been placed in Brandt Island or in the ODMDS and permanently removed from the littoral system. A review of the boring logs from the Inner Harbor identified a section of the Inner Harbor where sand content is greater than 80%, but less than the 90% sand used for beach disposal. This section of the Inner Harbor has been designated as acceptable for either of the Nearshore Placement Areas (Nearshore West or East) when practicable; inclusion of this material in nearshore placements will improve retention of sediment within the littoral system.

2) The second is the main navigation channel reaches that contain sediments that are used for beach disposal in year 1 of the 3- year Harbor maintenance cycle. Material dredged from this section in years where there is no beach disposal operation has typically been placed in the Nearshore West or in the ODMDS during adverse weather conditions. The inclusion of material from this section of the channel into the newly proposed Nearshore East should reduce future deflation of the eastern lobe of the ebb tide delta. In addition, providing additional placement areas within the littoral zone may reduce weather related disposal of the dredged material in the ODMDS (should this option be made available to contractors in the future) which would reduce future ebb tide delta deflation.

Quantities of material dredged in non-beach disposal years that exceed the annual losses to the ebb tide delta may be available for beach disposal by a local entity. Any requests by local entities to place this excess dredged material on adjacent beaches would be evaluated on a case-by-case basis. The excess material would be required to remain within the Beaufort Inlet system and as such, would only be available for disposal within the limits described in Section 3.2.2 Beach disposal. Disposal of dredged material from the Beaufort Inlet complex west of station 59 on Bogue Banks (Figure 3-9 Proposed Bogue Banks Disposal Area) would remove material from the complex and potentially increase delta deflation and for this reason would not be acceptable.

In order to monitor the evolution of the ebb tide delta and verify anticipated migration of material from the Nearshore Placement Areas to the surrounding ebb tide delta, an extensive monitoring program has been developed and is included as Appendix F (Morehead City Harbor Monitoring Plan). Monitoring is proposed to include semiannual beach profile survey collection, pre- and post-disposal surveys of the entire Nearshore

Placement Areas including a 1000’ buffer area, annual aerial or satellite photography, and biennial surveys of the ebb tide delta lobes. These data will be evaluated annually and the results of these analyses will be considered in determining future disposal methodology. If monitoring indicates that the Nearshore Placement Areas are becoming too shallow for dredges to access, those areas, pending coordination and environmental review, may be expanded to facilitate continued placement of material in the ebb tide delta.

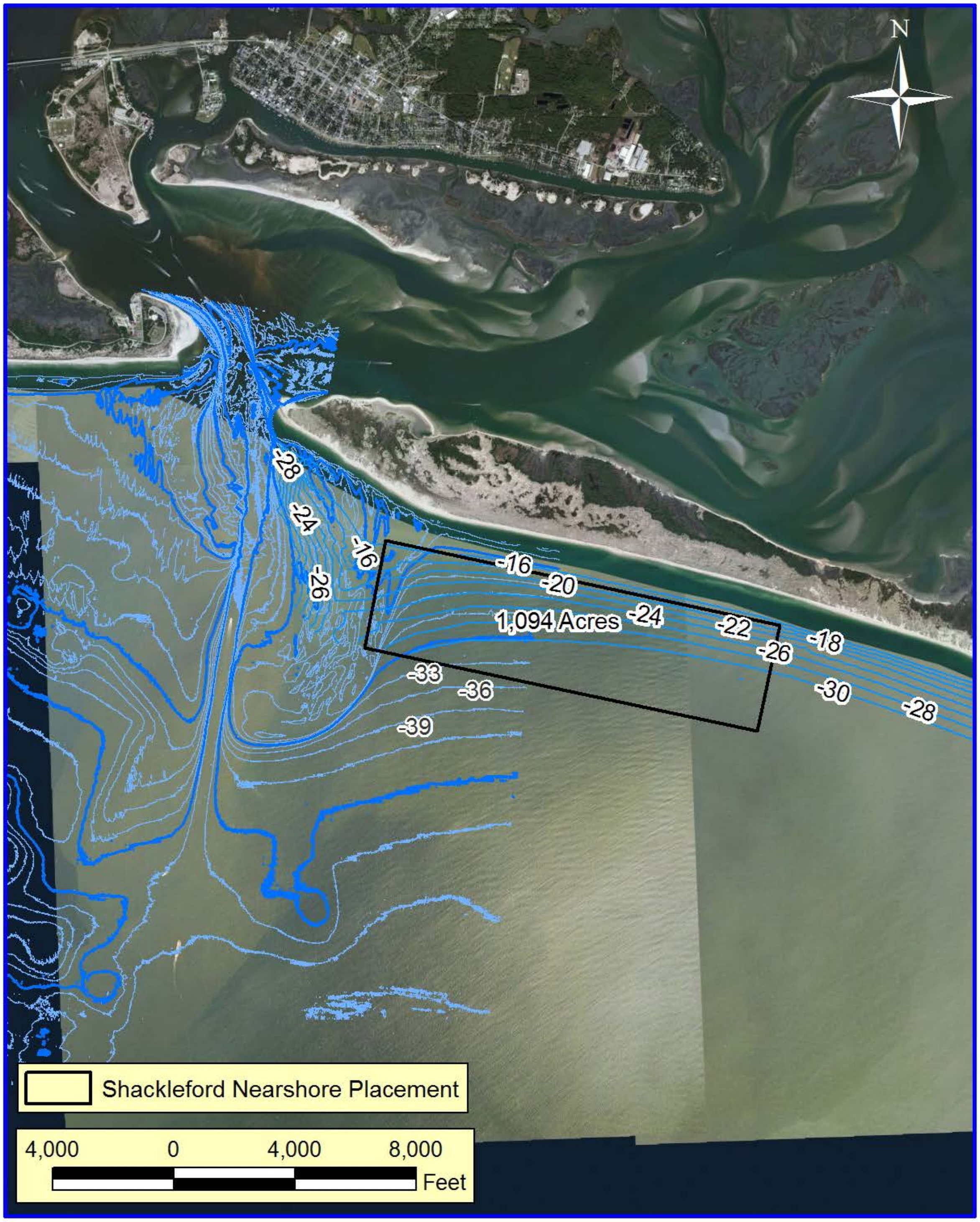


Figure 3-23. Proposed Nearshore East Placement Area

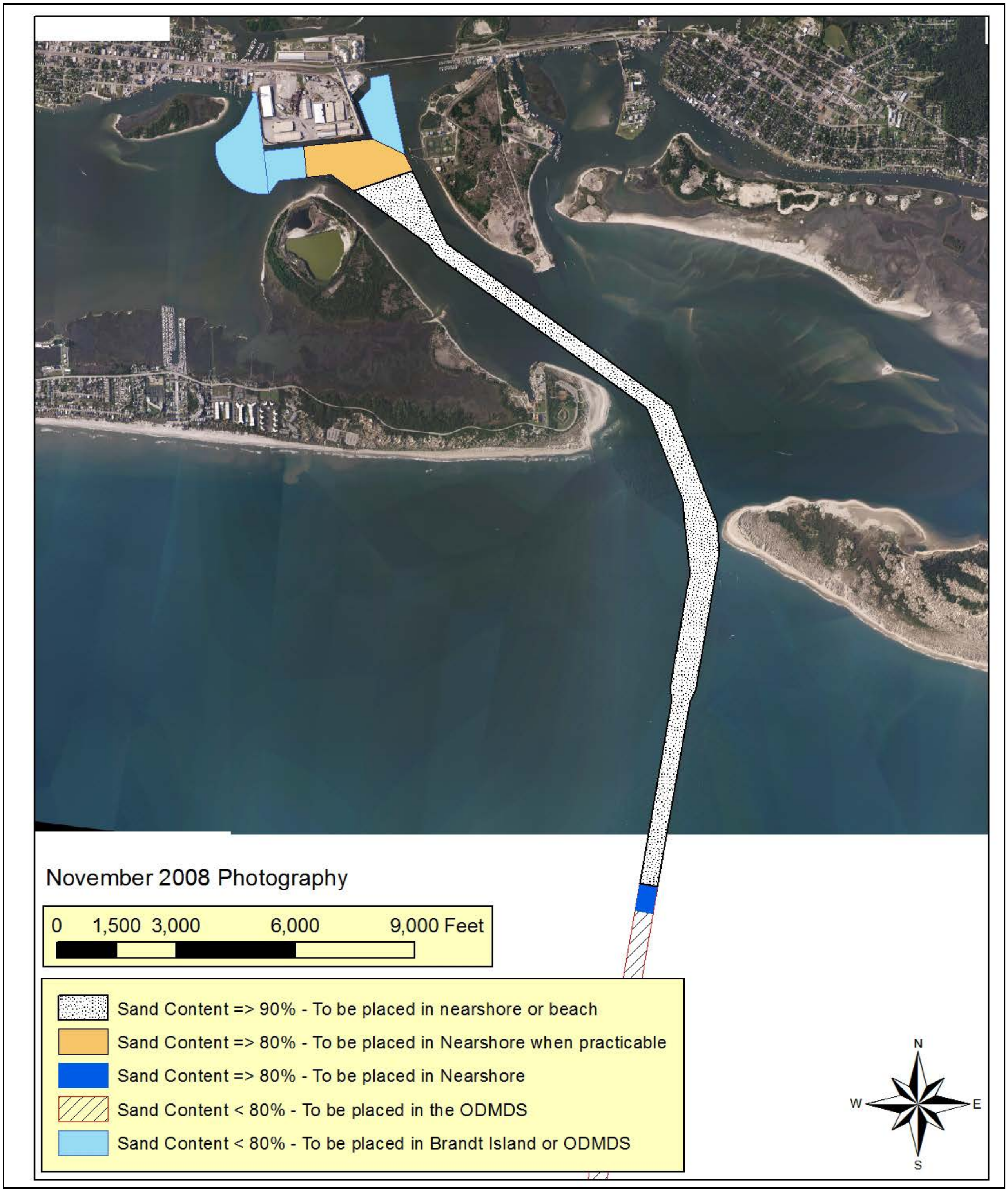


Figure 3-24. Inner/Outer Harbor Dredged Material Separation Based on % Sand

3.2.5 DMMP Measures Eliminated

Several measures considered and investigated for disposal/placement of maintenance dredged material for the Morehead City Harbor navigation project have been eliminated from further consideration for this DMMP and are described below. Although the measures described below have been eliminated from further consideration, for comparison purposes, several of them are included in the trade-off analysis in Section 3.5.1. Measures below that are beyond the scope, authority, or timeframe of the DMMP were not included in the trade-off analysis.

3.2.5.1 Brandt Island Dike Raises Along Existing Alignment

Description: If dredged material from the Inner Harbor continues to be disposed of in Brandt Island, capacity would be reached in 2028, well before the 20-year timeframe addressed by this DMMP. Measures that would prolong Brandt Island's longevity were investigated. Four potential dike heights were investigated to determine if it would be economical to raise the existing dike at Brandt Island. Dike heights investigated included elevations of 42 feet NAVD88, along with elevations 47, 52, and 55 feet NAVD88. The amount of fill needed to construct these dike heights and the resultant storage capacities are shown below in Table 3-8. Note: The storage volumes below include the existing capacity of 3 million cubic yards.

Existing Dike Alignment		
Dike Height (elev)	**Dike Fill Volume (CY)**	**Total Storage Volume (CY) (assumes dike fill comes from interior of diked area)**
42'	62,000	3,482,000
47'	191,000	3,854,000
52'	398,000	4,142,000
55'	582,000	4,244,000

Table 3-8. Brandt Island Dike Raises Along the Existing Dike Alignment

Issues: Expansion with dike raises provides much more capacity for the money than dike raises along the existing alignment (Section 3.2.5.1). As an example, expanding the dike and raising it to a height of 52 feet provides 35% greater capacity for less cost per cubic yard than a dike height of 52 feet along the existing alignment. A cost summary for all dike heights considered is included in Section 3.3 (Costs of the Alternative Plans) and detailed costs are included in Appendix G.

Conclusion: It is by far more feasible to expand and raise the dikes at Brandt Island than to raise them in place, therefore, raising the dikes along their current alignment was eliminated from further consideration.

3.2.5.2 Brandt Island Transfer of Material to the ODMDS

Description: Another measure considered to regain capacity at Brandt Island is a one-time pumpout with transfer of material to the ODMDS. This measure assumed the following:

- Access would be gained through the north dike wall adjacent to the spillway system.
- The access channel would be 100 feet wide and 20 feet deep with 3H:1V sideslopes.
- Approximately 100,000 cubic yards of material would have to be manipulated to open and close the dike.
- The interior pumpout would roughly follow the limits of the current ponded area down to elevation -20 feet msl.
- The existing quantity of material in the ponded area is 812,000 cubic yards (box cut with no sideslopes) plus the remaining capacity of Brandt Island, which is approximately 3,000,000 cubic yards. The total quantity of material to be removed and hauled to the ODMDS would be approximately 3,812,000 cubic yards.

Issue: Based on a cost estimate prepared using the assumptions above, transfer of dredged material from Brandt Island to the ODMDS would cost approximately $37 million over the 20-year life of the DMMP. If adequate funding was available to transfer the dredged material from Brandt Island to the ODMDS, then following clean-out of Brandt Island, dredged material disposal could resume in Brandt Island – the least cost option. However, it's unlikely that $37 million would ever be available to fund the clean-out, so once Brandt Island reaches capacity in 2028 the most feasible option is to dispose of the material in the ODMDS, which would cost an average of about $1million a year from 2028 to 2034.

Conclusion: Once Brandt Island reaches capacity, based on current cost estimates, it is much more feasible to expand and raise the dikes at Brandt Island or to take maintenance dredged material from the Inner Harbor directly to the ODMDS rather than attempting to restore capacity in Brandt Island by transferring material from Brandt Island to the ODMDS. For this reason, the one-time pumpout of Brandt Island to restore capacity has been eliminated from further consideration in this DMMP.

3.2.5.3 Recycle Material in Brandt Island through Hydrocyclone Density Separation

Description: Another measure considered for managing Brandt Island and the mixed material within it is the use of Hydrocyclone Maximum Density Separators (MDS). A Hydrocyclone MDS is a relatively old technology that is used in the mining industry for aggregate separation, but its application in the dredging industry is relatively new. The driving force behind the technology is the principal of centrifugal force. A slurry mixture of water and silt/sand is pumped into the hydrocyclone system at relatively low pressure at an angle which results in a high angular velocity. This velocity forces coarse material toward the walls of the hydrocyclone while creating an area of low pressure in the center of the hydrocyclone. This low pressure vortex where the majority of liquid and fine material gathers is forced upward through the overflow outlet located on the top of the hydrocyclone. The coarser material continues down the walls of the hydrocyclone and exits through the bottom and is referred to as “underflow” (Figure 3-25).

The Brandt Island disposal facility has potential for deployment of this technology. The island contains large quantities of sand that are currently inaccessible through conventional dredging methods due to the mixing of sediments during previous island disposal operations. There are several potential benefits to sediment separation within the disposal island which include: 1) Beneficial use of extracted coarse-grained sand for beach placement; 2) Nourishment of the deflated Beaufort Inlet ebb tide delta; 3) Use of overflow sediments for marsh creation; and 4) Reduction of the current volume within Brandt Island. This would reduce the future need for increases in the capacity of Brandt Island by either expanding and increasing the dike elevation or removal of material through hydraulic pumpout and disposal in the ODMDS.

Issues: 1) Several factors influence the efficiency and practicality of the use of this technology at Brandt Island. First, the hydrocyclone diameter and flow rate determine the grain size separation values and would be based on typical beach grain sizes (#200 sieve). To produce coarse-grained sandy material, a hydrocyclone of approximately 24-inch diameter would be required (Heibel 1995). Given the relatively small flow rate of the 24-inch hydrocyclone, approximately 2000 gallons per minute (gpm) with a 5:1 liquid/solid ratio, a bank of hydrocyclones would be required to operate simultaneously. Even with several hydrocyclones in operation continuously, the operation would take several months to complete. This duration would depend on the depth and width of material removed from Brandt Island, which has not yet been determined.

2) Material within Brandt Island would need to be handled multiple times during the separation process thus adding to the overall cost. The material would need to be screened to remove debris that would not be acceptable for beach disposal. This would require placement offshore or the establishment of a containment area for this unusable material. In addition, containment areas or disposal methods for the overflow material (finer than #200 sieve) would need to be created.

3) Since the hydrocyclone operation is in a fixed position, a method of removing the coarse-grained material produced would need to be developed. Unlike the overflow material which is pumped to a disposal area or barge, the underflow is relatively dry and would need to be moved by conveyor or mechanically loaded and trucked to a location where it could be hydraulically pumped at a later time. The isolated location of Brandt

Island makes it difficult to mobilize necessary equipment and the lack of existing haul roads or staging areas makes a truck haul operation impractical at this time.

Conclusion: Given the lack of established methods for employing this method of sand separation and the lack of information related to the associated costs and durations, this measure is not considered a viable option for the Morehead City Harbor DMMP at this time. As this technology develops and the need for additional space is required within Brandt Island, this option may be reevaluated. Brandt Island is not expected to reach capacity for at least the next 20 years, therefore this alternative is not included in the trade-off analysis.

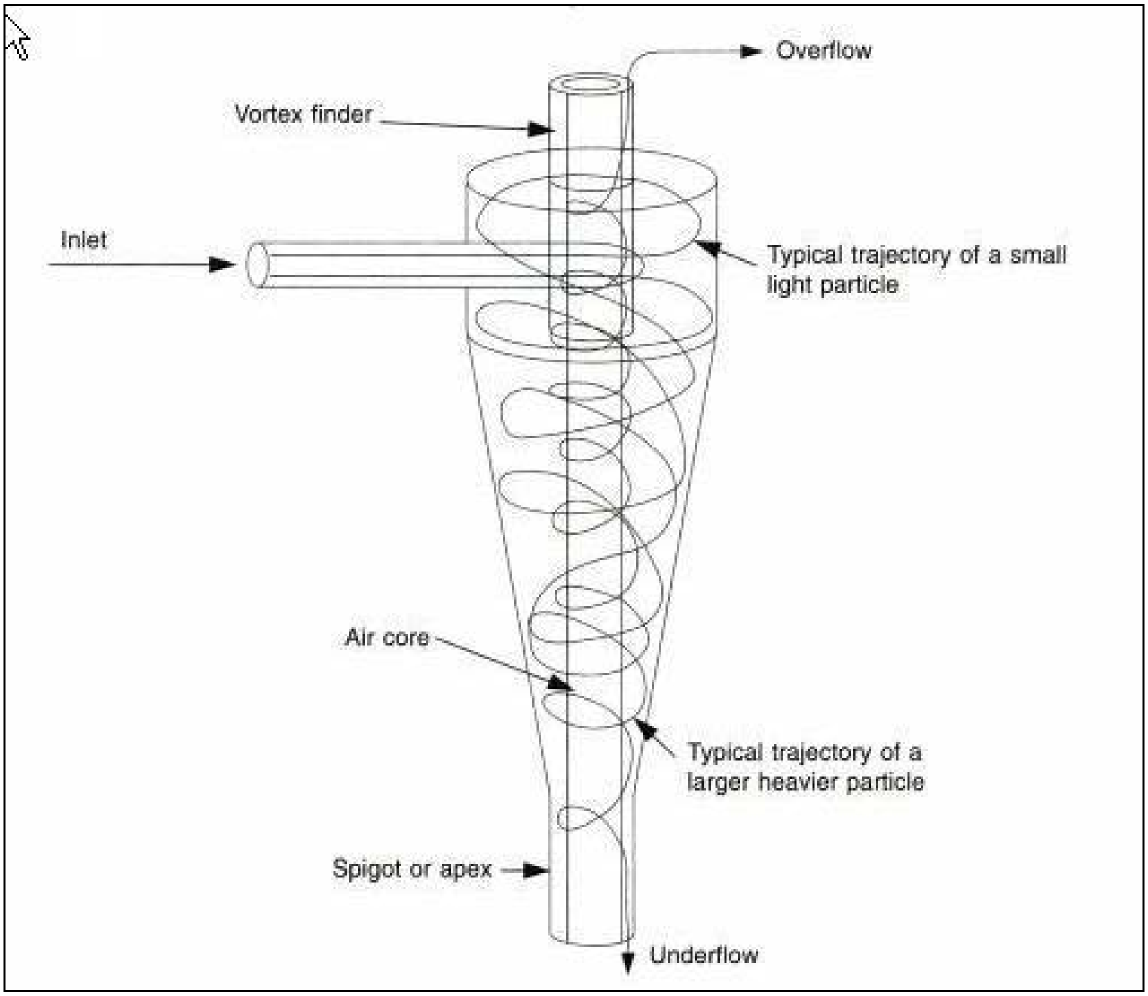


Figure 3-25. Typical Hydrocyclone Configuration

3.2.5.4 Continue to Use Existing Nearshore West Placement Area (Without Expansion)

Description: As previously discussed, one of the recommended disposal measures for the DMMP is shoreward expansion of the existing nearshore placement area on the west side of Beaufort Inlet (3.2.4.2, Ebb Tide Delta Placement West of Beaufort Inlet). Another measure considered was the continued use of the existing nearshore placement area without expansion.

Issue: It is possible to continue to use the existing nearshore placement area for a limited amount of time without expansion, however, expansion provides two important benefits that would not otherwise be realized: 1) It facilitates the diffusion of placed material toward the ebb tide delta, and 2) increases site longevity.

Conclusion: Expanding the existing nearshore placement area provides greater benefits than leaving it in its current configuration. The existing configuration has limited capacity, which would be increased by expansion. Also, expansion toward the shoreline would facilitate movement of placed material toward the ebb tide delta, which is important in ameliorating ebb tide delta sediment losses. Therefore, continued use of the existing nearshore placement area without expansion, although a possibility, is not recommended as part of the base plan. It should be noted that cost was not an important factor in the evaluation of this measure as expansion of the Nearshore West costs only slightly more than continued use without expansion. The slightly higher cost is attributed to the additional area requiring coverage by the ongoing environmental surveys and future monitoring. However, the benefits of expansion offset these costs. .

<u>3.2.5.5 Modification of Environmental Windows</u>

Description: Environmental windows have been implemented to protect important resources from impacts due to dredging or disposal of dredged material. Resources of interest are sea turtles, shorebirds, colonial nesting waterbirds, juvenile fish and shrimp.

Current environmental windows for the Morehead City Harbor are based on dredging methods and the location of disposal. The following guidelines have been used and coordinated with resource agencies:

- Hopper Dredging: January 1 thru March 31 (Wilmington District USACE protocol for sea turtles). This hopper window is more stringent than the one found in the terms and conditions of the Regional Biological Opinion on hopper dredging by NOAA Fisheries, dated September 25, 1997 (NMFS 1997).

- Pipeline and Bucket/Barge: Inner Harbor window is being discussed with NCDMF. Pipeline with disposal on Bogue Banks; November 16 to March 31 for beach disposal on Shackleford Banks due to potential for nesting birds. Pipeline dredging with disposal to Brandt Island may be year-round, if no impacts to nesting birds (April 1 thru August 31). Dredged material placement in the nearshore areas off Bogue Banks and Shackleford Banks is proposed from January 1 through March 31.

In the Morehead City Harbor, hopper dredging takes place only from January 1 to March 31 of any year and uses the terms and conditions of the Regional Biological Opinion on hopper dredging by NOAA Fisheries, dated September 25, 1997 (NMFS 1997). NMFS Biological Opinion (BO) dated September 25, 1997 authorizes the continued hopper dredging of channels and borrow areas in the Southeastern United States.

Issue: The environmental windows currently in place have been coordinated with State and federal regulatory agencies, and are protective of resources of concern. Modification of these windows may seem reasonable but could, in practice, cause adverse impacts to resources or the USACE' ability to maintain the project. For example, the Wilmington District USACE hopper dredging protocol for sea turtles is more restrictive than the Regional BO (NFMS 1997) for sea turtles due to the history of turtle takes during dredging of the Morehead City Harbor channels with hopper dredges. Not only is the CESAW protocol more protective of sea turtles in the project area, but it also reduces the potential for turtle takes that would not only impact work in North Carolina, but could potentially impact hopper dredge work throughout the South Atlantic Division.

Conclusion: Because current environmental windows are effective in protecting important resources, it would not benefit the long-term management of dredged material from the Morehead City Harbor project to propose changes at this time. Plans are to further coordinate the current (IOP) Inner Harbor dredging window with NCDMF. Should conditions change or new species of interest be identified, the environmental windows could be reevaluated during a regular reevaluation of the DMMP, or during appropriate coordination activities to address newly listed (threatened or endangered) species.

3.2.5.6 Creation of Colonial Nesting Waterbird Islands

Description: Quality nesting habitat for colonial waterbirds is a limited resource in North Carolina. A beneficial use of dredged material is placement of sand by control-of-effluent method to create and maintain islands at an early ecological successional stage for colonial nesting waterbirds. For this measure, the assumption was made that each island is circular and is about 15-acres in area, and 5 feet in elevation. Sand bags and/or geo-tubes would be placed along the circumference or perimeter of each island and then coarse-grained maintenance dredged material would be placed within the center of each island. This material would be excavated by pipeline dredge or hopper dredge from Outer Harbor ranges that contain coarse-grained material. Current water depths at the proposed bird island sites are about 5 feet.

Issues:

1) Essential Fish Habitat (EFH) – The areas of Bogue and Back Sounds that would be potentially suitable for island creation are designated as EFH. Construction of islands would involve conversion of approximately 15 acres of bottom habitat for each island constructed. Areas impacted would have to avoid EFH resources such as hard bottom and Submerged Aquatic Vegetation (SAV). Creation of one or more islands could potentially benefit SAV by creating sheltered areas from high-energy wave and wind action thereby enhancing SAV

habitat around the island. This effect has been seen around other control-of-effluent islands in North Carolina.

2) Suitable material requirements – Colonial nesting waterbirds prefer areas that are barren and consist of mainly coarse sand and small quantities of shell hash. As such, the North Carolina Wildlife Resources Commission recommends that material placed on these islands be greater than 90% sand (i.e., less than 10% fines).

3) Island size limitations – The size of the islands constructed and therefore the amount of material that could be placed on them would be limited. To prevent the establishment of mammalian predators on the islands, size must be limited to no more than approximately 15 acres. Height above the mean high water level is important because heights above 10 feet expose birds to higher winds and sand movement across the islands. The amount of material required to construct islands would be limited; for example, an island of approximately 15 acres and 5 feet high would require about 121,000 cubic yards. Two 15-acre islands would require approximately 242,000 cubic yards of coarse sand (i.e., greater than 90 % sand). This maintenance material would be excavated from the Outer Harbor by either pipeline dredge or hopper dredge, depending on the exact location of dredging. Dredged material from the Inner Harbor would be too fine to use for bird islands. Maintenance material from Range A is primarily dredged by hopper. Follow-up disposal of material would require less material depending on rates of erosion from the island.

4) Cost - Assuming a bird island would require approximately 121,000 cubic yards of material to construct, the cost for dredging would be approximately $2,178,000 plus the cost of geotubes at $1,500,000 or $3.7 million per island or a cost of $7.4 million for both islands. This estimated cost does not include contingency, inflation, equipment costs (personnel, bulldozer on the island moving the end of pipeline or pushing sand, etc.), overfill factors, construction delays, etc. The detailed cost estimate is included in Appendix G, Costs.

Conclusion: The additional costs required to construct the islands are significantly greater than placing the material on nearby beaches or in the ebb tide delta (base plan), therefore the PDT recommends that the construction of the proposed Colonial Nesting Waterbird Islands be eliminated from further consideration for the Morehead City Harbor DMMP. However, this is a potential beneficial use of dredged material that could be pursued under separate federal authority – Section 204 of WRDA 1992, Beneficial Use of Dredged Material.

3.2.5.7 Dispose of Dredged Material on North Radio Island

Description: Radio Island is located to the east of the existing Port of Morehead City, across the Intracoastal Waterway between the Port and Beaufort, NC (Figure 1-4 inset). Figure 3-26 is an aerial photograph of Radio Island showing its relationship to the existing Port, Morehead City, and Beaufort. The NCSPA owns approximately 185 acres on Radio Island. The southeastern portion of the island, known as East Beach, is currently designated a public access area and is used for recreational purposes. The northern end of the island (North Radio Island), north of US 70, contains an active sand recycling site managed by the NCSPA, and the western shore of this area is a public access area owned by the Town of Morehead City. The southern tip of the island is owned by the US Navy and used for military deployment activities.

This measure considered disposal of coarse-grained dredged material in the existing North Radio Island disposal site. Because the site is an active sand recycling site, the NCSPA only allows disposal of dredged material that contains greater than 80 % sand. The site is approximately 32 acres in size and has a capacity of approximately 105,000 cubic yards. However, in June 2011, a six slip public boat launch facility was constructed, thus reducing the overall size and capacity of the diked disposal area by approximately 25 %. Therefore, the new diked area would be about 9.3 acres in size and its capacity would be about 79,000 cubic yards. Also, the NCSPA has a long-term plan (schedule undetermined) to expand, which could further impact the availability of Radio Island for future use.

Issue: The current capacity of the North Radio Island site would not accommodate the fine-grained material that would result from dredging of the Northwest and West Legs of the Inner Harbor.

Conclusion: The capacity of the North Radio Island disposal site is too small to make this a feasible measure, therefore, disposing of dredged material on North Radio Island was eliminated from further consideration.

Figure 3-26. North Radio Island Disposal Area

3.2.5.8 Dispose of Dredged Material on Marsh Island

Description: Marsh Island is located north of the existing Port of Morehead City, across Calico Creek. The island is an inactive dredged material disposal site, approximately 58 acres in size (Figure 3-27). The capacity of the existing diked area at Marsh Island is so small that this option considered expanding the existing dike and possibly increasing the dike elevation as needed to accommodate more dredged material. This measure did not consider dike expansion into wetland areas as mitigation costs would render this measure too costly to implement.

Issue: The existing diked disposal area is about 9 acres in size and its dredged material capacity is approximately 7,500 cubic yards. The existing dike height is 14.5 feet NAVD88. Even if the dike could be expanded to encompass non-wetland areas it would only provide about 128,000 cubic yards of dredged material capacity which is less than required for one dredging event. This capacity estimate assumed the dike would not be raised, but would remain at its current height of 14.5 feet NAVD88.

Conclusion: Marsh Island is so small that it does not provide adequate capacity to be considered a viable measure. For this reason, disposing of dredged material on Marsh Island was eliminated from further consideration.

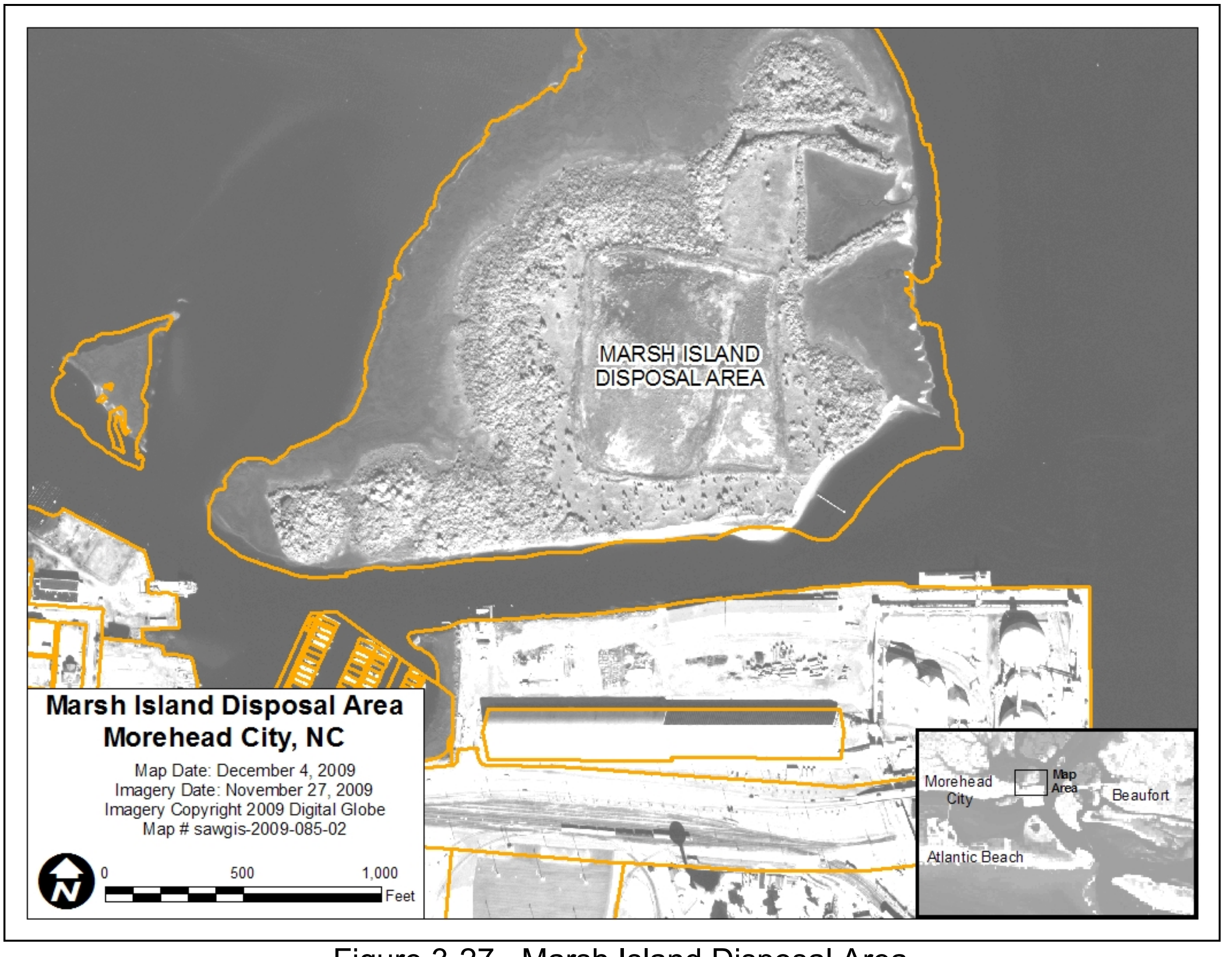


Figure 3-27. Marsh Island Disposal Area

3.2.5.9 Use Dredged Material to Create Wetlands

Description: The marshes of Bogue Sound are important habitat for fish and wildlife resources and support recreational and commercial activities that rely on these resources. Some of the marshes are eroding in the project area. These marshes provide an important function as nursery habitat for estuarine fish and shellfish and support a rich and diverse benthic fauna. The fish, invertebrates, and plant detritus produced within the marsh are important components of the food web, essential for the production of seafood which helps support recreational and commercial marine activities in the area. Studies in Louisiana have shown that the area of intertidal wetland is directly proportional to the commercial shrimp harvest (Turner 1979). Many species of birds and mammals are also supported by the marshes of Bogue Sound. The construction of shallow water marsh habitat may significantly enhance feeding opportunities for migrant waterfowl, shorebirds, wading birds, and mammals.

In addition to the environmental benefits provided by creating marshland, the construction of the proposed marsh would protect existing marsh from continuing erosion and overwash from boat wakes and would help stabilize the Harbor area.

The Morehead Harbor DMMP PDT looked at other possible measures for the placement of dredged material within intertidal areas of Bogue Sound. The construction of shallow water marsh habitat in Bogue Sound would be a beneficial use of dredged material (in accordance with Section 204 Program (Beneficial Use of Dredged Material for Ecosystem Restoration) of the Water Resources Development Act of 1992.

Issues:

1) Dredged material volumes - The volume of material that would be needed to create wetlands, relative to the quantities removed annually from the Harbor channel, are miniscule and would not provide a cost effective dredged material disposal option.

2) Dredge equipment - Maintenance dredging of Morehead City Harbor is typically accomplished by a large pipeline dredge or hopper dredges. These large floating plants cannot operate safely in the shallow areas required for wetland creation and employing smaller dredge equipment or barges for the purpose of creating wetlands would not be feasible.

3) Resource Agency Concerns - The North Carolina Division of Water Quality has designated Bogue Sound as an Outstanding Resource Water (ORW) due to the high quality waters. Obtaining approval from the State to convert portions of existing shallow water habitat to marsh habitat would be very challenging, if not impossible.

4) Cost - Based on experience in doing similar wetland creation projects within Wilmington District, the estimated average per acre cost would be about $240,000. This cost only considers the actual construction of the wetlands and

wetland planting and does not include additional costs that would be incurred to modify the disposal methodology (typical equipment is too large) nor the costs to monitor wetland success, which would be required by the resource agencies. Considering all potential costs, this measure would be considerably more costly than the base plan.

Conclusion: For the reasons described above, this measure was eliminated from further consideration in the DMMP. However, wetland creation using dredged material may be pursued under separate federal authority.

3.2.5.10 Construct a New Upland Disposal Site

Description: Another measure considered for the Morehead City Harbor DMMP was the construction of a new upland disposal site. To be viable, a new site would have to be at least as large as Brandt Island (~168 acres) and similar in proximity to the Harbor as the existing Brandt Island disposal site. Aerial photography of the area was used to identify any potential future sites 150-200 acres in size within a radius of 2 miles of the Harbor (Figure 3-28).

Issue: Analysis of aerial photography within a 2 mile radius of the Morehead City Harbor reveals that there are no undeveloped uplands of the size required to construct a new disposal site.

Conclusion: Due to a lack of undeveloped uplands in the Harbor vicinity, construction of a new disposal site is not viable. Even if land was available, the cost to purchase the land and construct a new site would be greater than the base plan. Due to the close proximity of Brandt Island and the ODMDS, any upland alternative would be more costly to construct and utilize than disposal in Brandt Island or the ODMDS. For these reasons, construction of a new upland disposal site was eliminated from further consideration. It should be noted that if land was available, creation of several smaller upland sites to meet the disposal needs of the Inner Harbor would be more costly than creation of one large upland site.

Figure 3-28. Area Considered for New Upland Disposal Site

3.2.5.11 Brandt Island Shoreline Stabilization

Description: One measure considered to potentially reduce dredging in the Morehead City Harbor navigation channels was the stabilization of the Brandt Island shoreline. In an attempt to identify the cause of the persistent shoaling within the Inner Harbor of the Morehead City Harbor navigation channel, an analysis of historic shoreline changes along Brandt Island was completed. Figure 3-29 is a vicinity map of Brandt Island that includes the shoreline transects used in the study to measure changes in the shoreline.

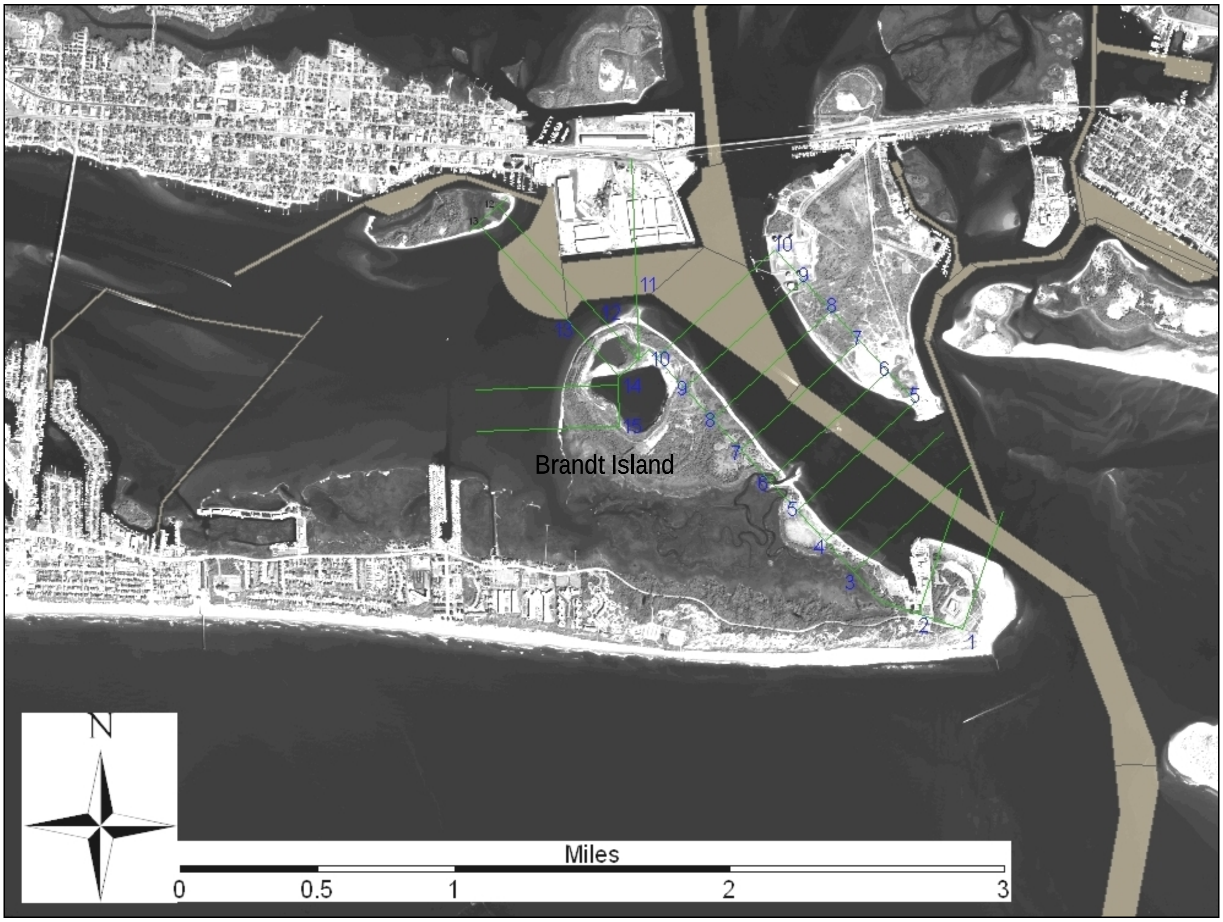


Figure 3-29. Brandt Island Shoreline Transects

The shorelines used in the analysis were extracted from historic aerial photography for this area from the following years:

1. May 1958 – 9” x 9” scanned prints
2. January 1964 – 9” x 9” scanned prints
3. August 1971 – 9” x 9” scanned prints
4. April 1974 – 9” x 9” scanned prints
5. June 1978 – 9” x 9” scanned prints
6. October 1988 – 9” x 9” scanned prints
7. Digital Orthophoto Quarter Quads (DOQQ) 1993 - orthorectified
8. DOQQ 1998 - orthorectified
9. October 2000 – 9” x 9” scanned prints
10. June 2002 – 9” x 9” scanned prints
11. February 2004 - orthorectified
12. January 2008 - orthorectified

The scanned prints were best-fit rectified using the January 2008 orthorectified image as control. Some error is to be expected in this process depending upon the prominence and number of features visible on both the scanned prints and the January 2008 orthorectified image used as control. Some of the photos did not cover the entire shoreline of Brandt Island, however these photos were incorporated to the maximum extent possible.

Shorelines were obtained from the photography through heads-up digitization for each of the photos and compiled in an ArcView shape file format. In addition to shorelines, a vegetation line and a "shoal line" (or shallow water break line) were also digitized. The shoreline and vegetation lines are rather easy to interpret compared to the shoal line. The distinction of a shoal line is highly dependent upon the clarity of the water, the tide level and currents at the time of the photo. For this part of the analysis, only the shoreline was used for further study. Shorelines for Radio Island, the Port of Morehead City and Sugarloaf Island (Figure 1-3) were digitized as well.

An arbitrary reference line was established from which perpendicular distances to the digitized shoreline were measured. An additional non-perpendicular line was included to capture shoreline measurements along the north shore of Brandt Island. The Brandt Island shoreline to reference line measurements are presented in Table 3-9.

Year	1958	1964	1971	1974	1978	1988	1993	1998	2000	2002	2004	2008
Brandt01	n/a	n/a	n/a	n/a	1,056	n/a	n/a	n/a	1,451	n/a	1458	1,422
Brandt02	1305	n/a	n/a	1,338	1,346	n/a	n/a	n/a	1,468	n/a	1437	1,449
Brandt03	734	711	605	609	561	n/a	n/a	n/a	413	422	390	412
Brandt04	652	591	261	262	247	n/a	n/a	n/a	228	240	219	238
Brandt05	370	427	428	448	398	233	285	n/a	246	245	228	248
Brandt06	292	265	212	403	490	418	260	333	303	309	320	321
Brandt07	438	445	312	367	349	211	370	366	346	347	357	360
Brandt08	439	389	367	416	385	266	415	426	380	370	397	420
Brandt09	374	431	386	n/a	439	329	479	471	436	412	444	467
Brandt10	362	510	382	n/a	467	341	442	462	n/a	381	434	442
Brandt11	420	800	512	n/a	633	594	701	685	n/a	n/a	723	800
Brandt12	362	1,015	827	n/a	1,059	866	895	914	n/a	n/a	891	885
Brandt13	129	794	851	n/a	1,054	1,044	996	991	n/a	968	934	954
Brandt14	44	497	949	1,136	1,101	1,180	1,105	1,103	1,103	1,103	1069	1,037
Brandt15	n/a	286	1,000	1,082	1,093	1,276	n/a	n/a	1,167	1,204	1187	1,160

Table 3-9. Distances from Reference Line to Shoreline – Brandt Island

The western shoreline of Radio Island and the southern shoreline of Sugarloaf Island were also digitized and measured in relation to a reference line. The reference line to shoreline distances are tabulated in Table 3-10 below:

Reference Line / Year	1958	1964	1971	1974	1978	1988	1993	1998	2000	2002	2004	2008
Radio05	342	226	174	n/a	110	n/a	n/a	79	135	n/a	108	129
Radio06	495	654	636	n/a	550	n/a	n/a	531	553	534	502	514
Radio07	242	315	497	n/a	507	867	n/a	626	n/a	688	643	655
Radio08	328	500	n/a	n/a	516	804	507	566	n/a	657	589	618
Radio09	390	445	n/a	n/a	406	n/a	382	390	n/a	n/a	390	412
Radio10	144	143	n/a	n/a	154	n/a	143	147	n/a	n/a	160	152
Sugarloaf12	499	456	n/a	n/a	426	n/a	371	339	n/a	n/a	275	288
Sugarloaf13	343	236	n/a	n/a	246	n/a	177	215	n/a	n/a	184	197

Table 3-10. Distances from Reference Line to Shoreline - Western Shore Radio Island / Southern Shore Sugarloaf Island

Figure 3-30 shows the location of reference lines and digitized shorelines overlaid on January 2008 photography. Note how the 1958, 1964 and 1971 shorelines show expansion of the north and west part of Brandt Island. During this timeframe the island was built up with dredged material in an uncontrolled manner until dikes were constructed to contain and control the deposition of dredge material. The island has retained its general shape since the late 1970's.

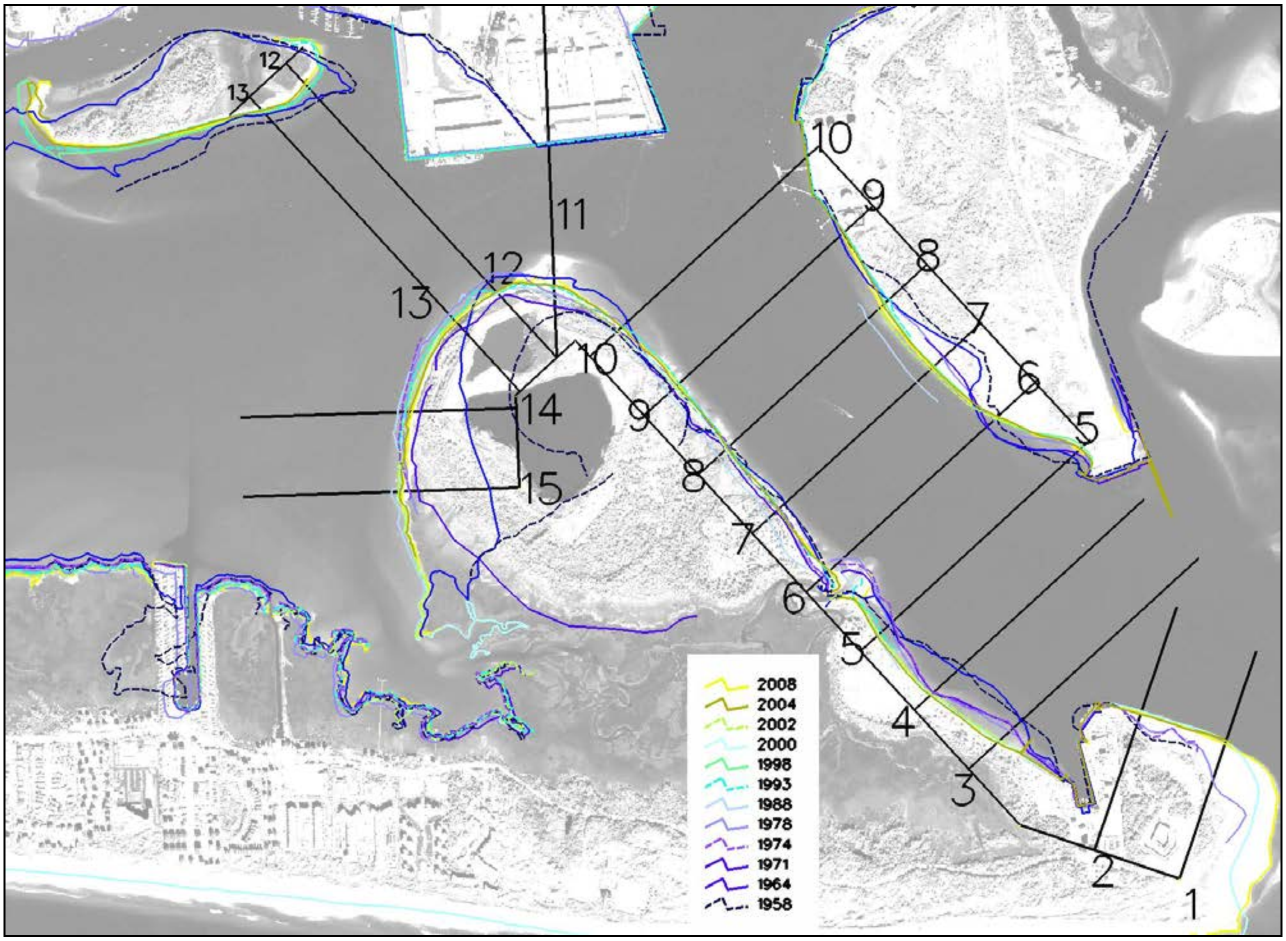


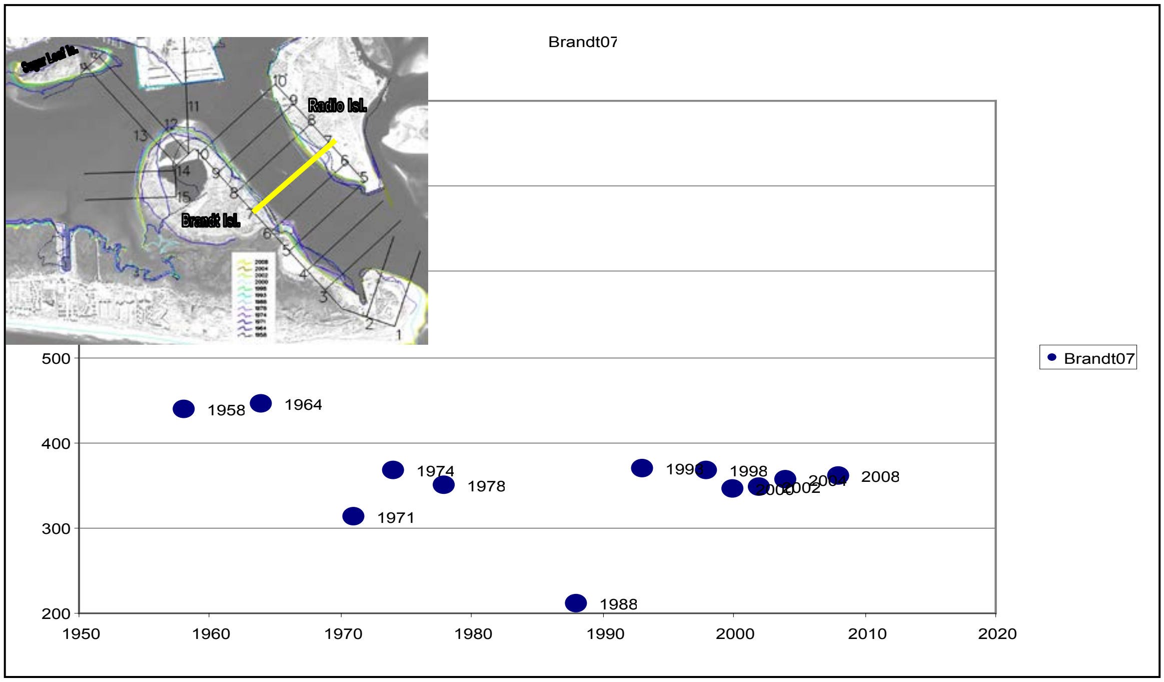
Figure 3-30. Reference Lines and Historical Shorelines

Plots are provided below showing the variation of distance from the reference line to the shoreline over time. This graphical plot helps to quickly discern any trends in shoreline movement over time.

The plots for reference lines 7 and 9 are shown in Figure 3-31. Reference lines 7 and 9 are generally representative of the adjacent reference lines along this east shore of Brandt Island and fail to show consistent erosion or accretion.

Figure 3-32 shows the shoreline distance plot for reference line 11. This plot shows a buildup of shoreline and is attributed to the proximity to an outfall pipe which drains the diked area. The outfall pipe is elevated with a timber structure which tends to trap migrating sediment.

Figures 3-33 and 3-34 show the shoreline distance plot for reference lines 14 and 15. The shoreline at reference line 14 and northward appears to be retreating according to the last several data points. This part of the island is exposed to the longest fetch distances and likely experiences larger wind driven waves.



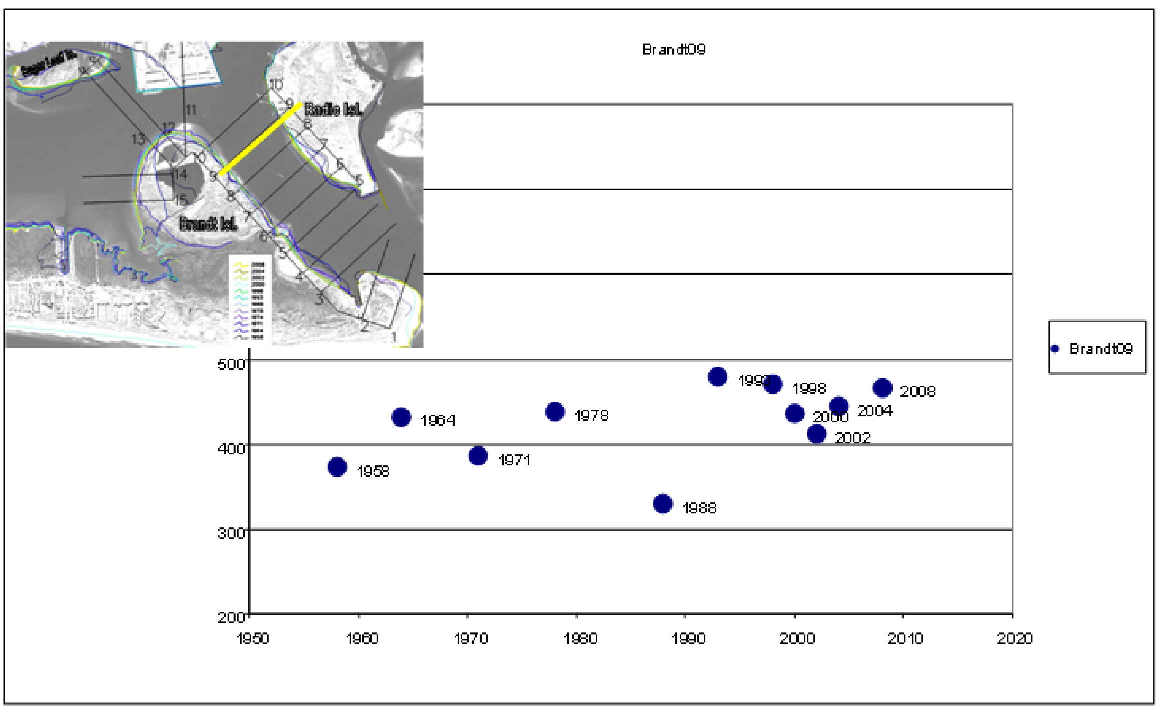


Figure 3-31. Reference Line to Shoreline distance vs. Time; Lines 7 and 9 Brandt Island

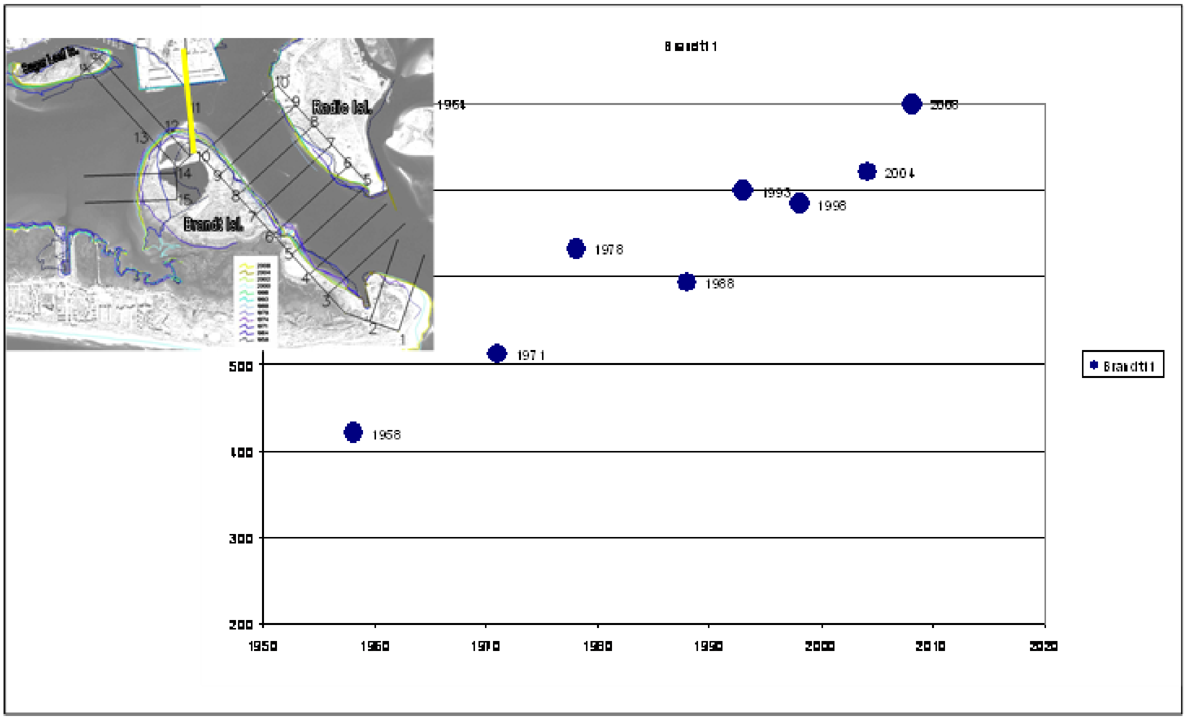


Figure 3-32. Reference Line to Shoreline distance vs. Time; Line 11 Brandt Island

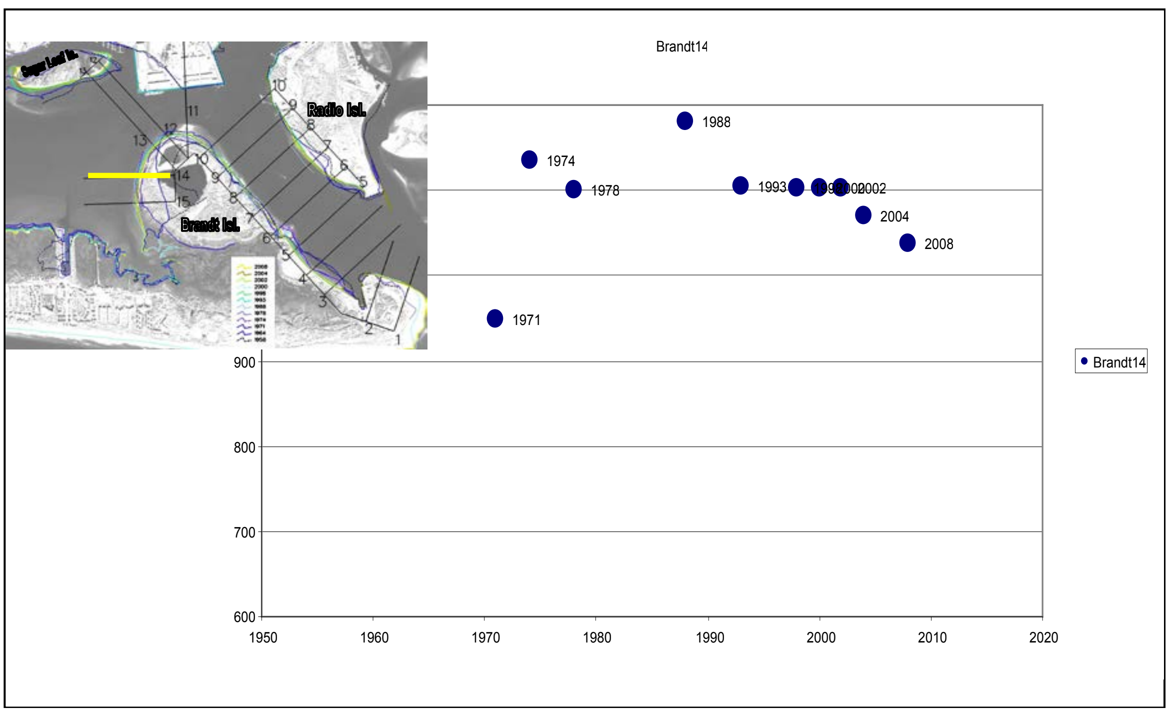


Figure 3-33. Reference Line to Shoreline distance vs. Time; Line 14 Brandt Island

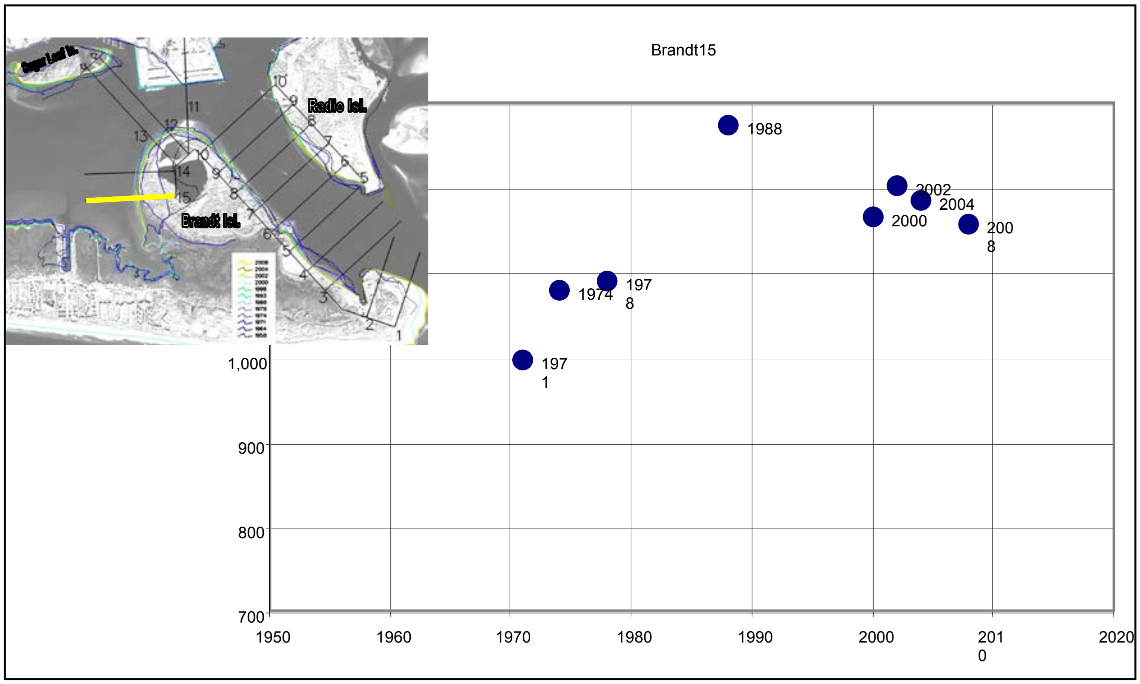


Figure 3-34. Reference Line to Shoreline distance vs. Time; Line 15 Brandt Island

Issue: With the exception of two areas: 1) The eroding shoreline facing West-Northwest (line 14) and 2) The accreting shoreline near the original outfall pipe (line 11), the Island shoreline appears to be relatively stable.

Conclusion: Due to the limited change observed within this analysis, a shoreline stabilization measure was not evaluated further.

3.2.5.12 Construct Jetties at Beaufort Inlet

Description: One measure considered to reduce shoaling within the navigation channel and retain sediment within the littoral flow was the construction of a jetty and sand bypassing system at Beaufort Inlet. Jetties are shore-connected structures typically constructed perpendicular to the shore and extending into the ocean which confine stream or tidal flow, thus reducing shoaling and dredging requirements, (USACE 2002). In addition to reducing shoaling within the channel, jetties serve to reduce longshore current and attenuate wave heights within the channel, which improves navigational safety.

Construction of jetties at Beaufort Inlet would produce impacts that are both predictable and unpredictable. One of the predictable impacts that would result from an obstruction in the nearshore would be shoreline accretion on the updrift side of the jetty followed by shoreline recession on the downdrift side of the jetty complex. To compensate for this blockage in the natural littoral flow, a sand bypassing system would be necessary to mechanically transport sand around the inlet on a periodic basis. There are several methods to accomplish this mechanical bypassing which include: mobilizing conventional dredge pumps on an as needed basis to clear the accumulation of sand on the updrift side of the inlet and transport it by pipeline to the downdrift location; construction of a permanent sand bypassing plant similar to that built at Indian River Inlet, DE where a jet pump is operated on a regular schedule to continually remove trapped sand to the downdrift side of the inlet, (USACE 2002); or by a bucket and barge operation where material could be dredged into a barge and then released in the nearshore placement area on the downdrift side of the inlet. Other impacts could include changes in the tidal prism and back bay erosion along the landward terminal end of the jetty.

Issue: Pursuant to Policy Guidance Letter 40, Development and Financing of Dredged Material Management Studies, dated 25 March 1993, management plan studies for existing projects shall be conducted pursuant to existing authorities for individual project operation and maintenance, as provided in public laws authorizing specific projects. New projects or project modifications beyond the O & M of the authorized project (Morehead City Harbor Navigation Project), require congressional authorization and should be pursued as cost shared feasibility studies with General Investigations funding. Where the need for such modifications are identified as part of dredged material management studies, operation and maintenance funding for the study of the modification should be terminated and a new feasibility study start sought through the budget process under the authority of Section 216 of the 1970 WRDA .

Conclusion: This measure is outside the scope and authority of DMMPs and therefore was eliminated from further consideration. As stated above, this measure may be pursued under separate federal authority.

3.2.5.13 Modify Existing Terminal Groin on West Side of Beaufort Inlet

A measure proposed during an early DMMP development meeting with the public was to rehabilitate or modify the terminal groin located on the east end of Bogue Banks in the vicinity of Fort Macon State Park. This structure, which was built in the early 1960's by the state of North Carolina, was intended to stabilize the shoreline that fronts the historic Fort Macon State Park.

Terminal groins are designed to retain sand and provide additional shoreline as a protective measure and/or to provide recreational area. Once the structure has retained sand to its designed width, it allows for natural by-passing of material down drift of the structure. Material by-passing the Fort Macon State Park terminal groin is generally deposited within the navigation channel, however some material has accumulated on the east end of Bogue Banks resulting in recently observed spit growth which is encroaching on the Morehead City Harbor Navigation channel. While the original design documents were not available at the time of this report, the structure appears to be an extension of a smaller groin within the existing groin field shown in Figure 3-35. The existing groin field is shown in the 1958 and 1962 photographs within Figure 3-35and the earliest available photography showing the newly constructed terminal groin is shown from 1974, also in Figure 3-35.

A photographic comparison is shown in Figure 3-35 that clearly shows the positive influence of the structure on the shoreline within the vicinity of Fort Macon State Park. The shoreline on the eastern end of Bogue Banks adjacent to the terminal groin accreted approximately 700’ between 1958 and 1974 as a result of the groin construction. The 1974 shoreline is overlaid on the August 2009 photography within Figure 3-35 to display how the shoreline in the vicinity of the terminal groin is in virtually the same location as it was in 1974. Further examination of available photography between 1974 and 2009 (Figure 3-36) shows that the shoreline cycles between accretion just after beach disposal along Bogue Banks followed by shoreline recession which reduces the shoreline approximately back to the 1974 position for the eastern 2000 feet of the island. This consistent minimum shoreline position in the area adjacent to the terminal groin would indicate that the groin is functioning much in the same way as it did when first constructed.

Issue: Since it appeared through this initial investigation that the terminal groin was operating much as it did when built, a rehabilitation of the structure does not appear necessary. To improve the groin functionality and possibly increase its ability to retain sand would require a detailed study of the structure including reviews of the initial design and purpose, existing wave and current patterns impacting the structure, physical structure surveys, and an analysis of environmental impacts related to changes of the structure length and porosity.

Conclusion: Due to the fact that the structure is not property of the federal government and these study items are beyond the scope of the DMMP, this measure was deemed not feasible at this time. As a separate project, the Wilmington District USACE in conjunction with the U.S. Army Engineer Research and Design Center is developing a wave and current model of Beaufort Inlet which includes the groin at Fort Macon State Park. This model, once developed, would be available for incorporation into future studies of the terminal groin.

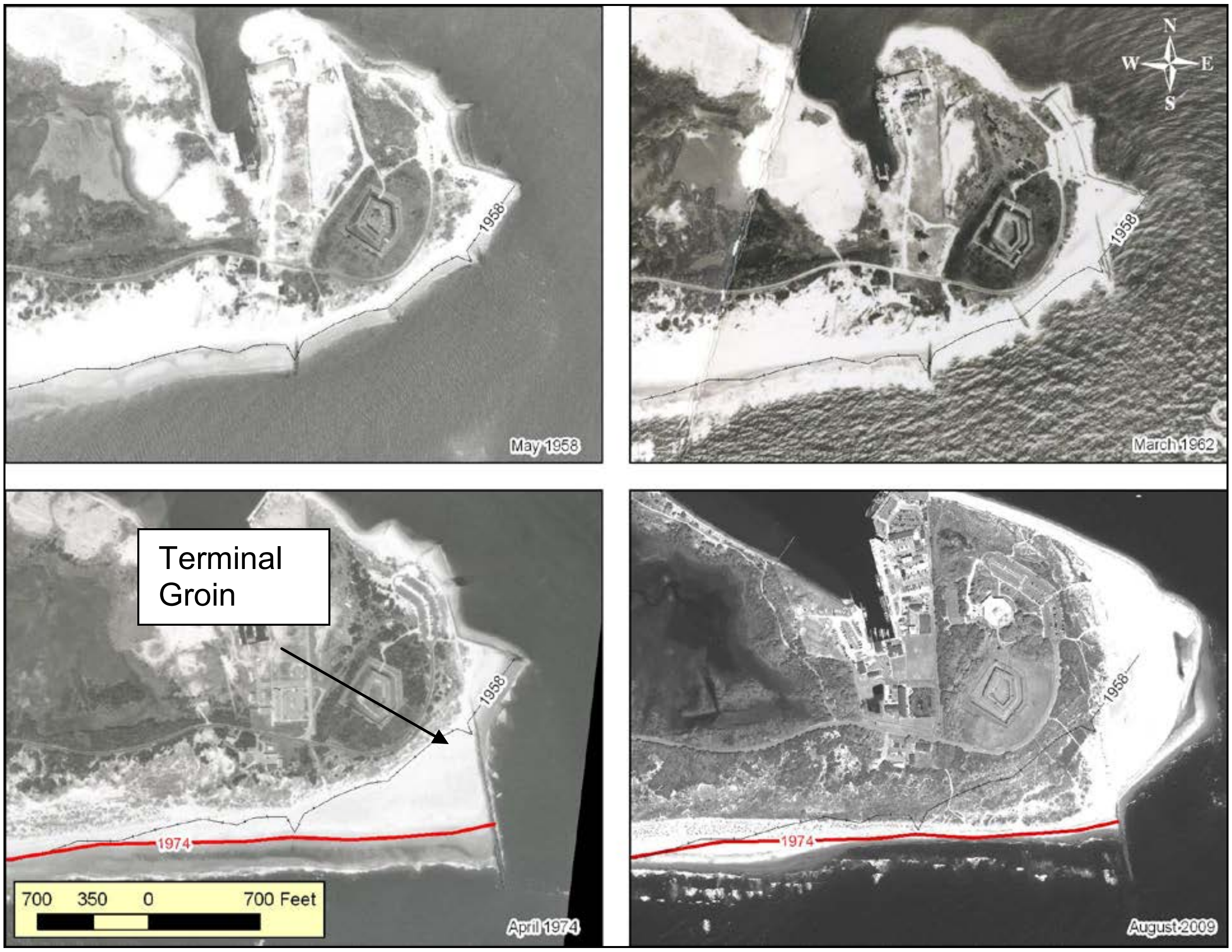


Figure 3-35. Fort Macon State Park Pre- and Post-Groin Construction

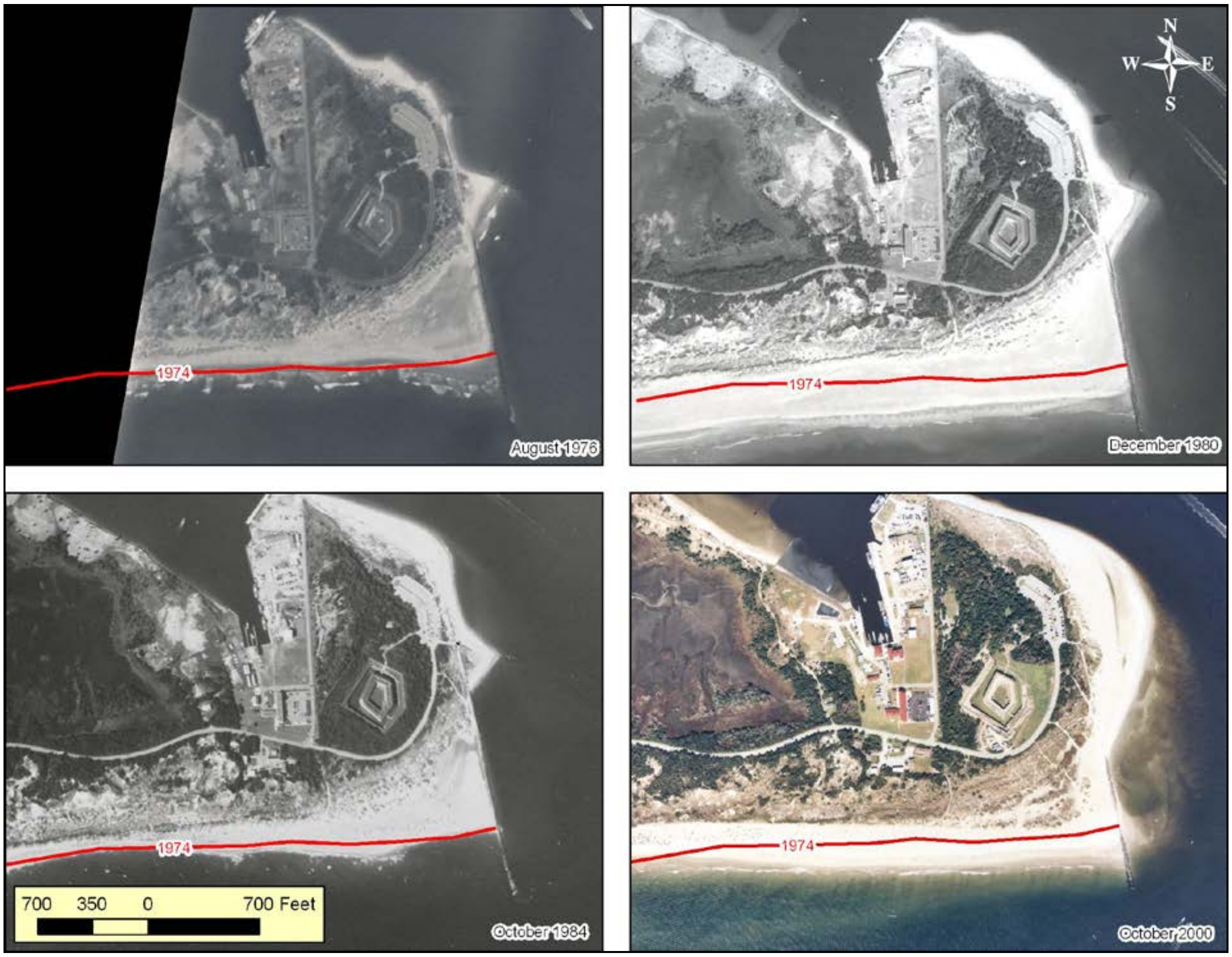


Figure 3-36. Fort Macon State Park Shoreline Fluctuation

3.2.5.14 Realign Morehead City Harbor Navigation Channel

Description: To reduce dredging requirements within the Morehead City navigation channel, an investigation into realigning the channel to follow natural flow patterns was suggested at a public discussion early in the DMMP process. An initial review of this proposal included a comparison of available historic bathymetric data from 1974, 1998, 2005, and 2009 which clearly shows that the ebb tide delta has deflated since 1974. In addition, the deflation patterns observed indicate that flow through the Inlet has caused extensive scour in two areas of the ebb tide delta, as shown in Figure 3-37. The probable cause of these scour areas is a redirection of current from the maintained navigation channel to a north-northwest orientation. This current jetting across the eastern lobe of the ebb tide delta results in material being removed from the existing ebb tide delta and deposited in deeper water, just south of the eastern ebb tide delta where velocities are much lower.

While the observed changes in bathymetric data within the ebb tide delta are a good indicator of current patterns, they do not replace the need for accurate current measurements and modeling of flow patterns within the Inlet complex. Sand deposition within the Inlet complex can affect the flow patterns which may result in changes in the main ebb channel. These sand depositions may be the result of direct placement of material within the ebb tide delta or natural changes. Deposition of dredged material within the nearshore placement area is an example of direct placement. A natural deposition can be observed on the east end of Bogue Banks where the spit has grown considerably, toward the navigation channel, since the early 1990's. This spit growth toward the channel could possibly be one cause for the redirection of the current to a more north-northwest alignment. Similarly the point of the spit on Shackleford Banks has accreted toward the navigation channel and could be impacting the inlet velocities and channel orientation.

Current and sediment transport modeling within the Beaufort Inlet complex would provide guidance to help determine the most sustainable channel orientation through the ebb tide delta. By adjusting the channel orientation to match the current flow patterns, shoaling of the navigation channel and therefore dredging requirements may be minimized. In addition, it would provide information on movement of material placed within the ebb tide delta and allow modification of placement areas and lift thickness to maximize the benefits of the placed material on the ebb tide delta. Currently the Wilmington District USACE in conjunction with the U.S. Army Engineer Research and Development Center is developing such a model for the Beaufort Inlet complex and it would be available, when complete, to attempt to answer some of these questions.

Issue: The ability to undertake a study which would analyze and recommend changes to the Morehead City Harbor navigation channel orientation is not within the scope of the DMMP. Further development of this measure would require extensive coastal modeling efforts, ship simulations, environmental studies, and geotechnical investigations, and cannot be pursued under existing authorities.

Conclusion: Pursuant to USACE policy, DMMPs may only address O&M of the currently authorized project and may not recommend changes to that project, with the exception of considering reduced channel dimensions, therefore, realignment of the navigation channel was not pursued further as part of the DMMP. However, realignment may be pursued under a separate authority, which would require official approval.

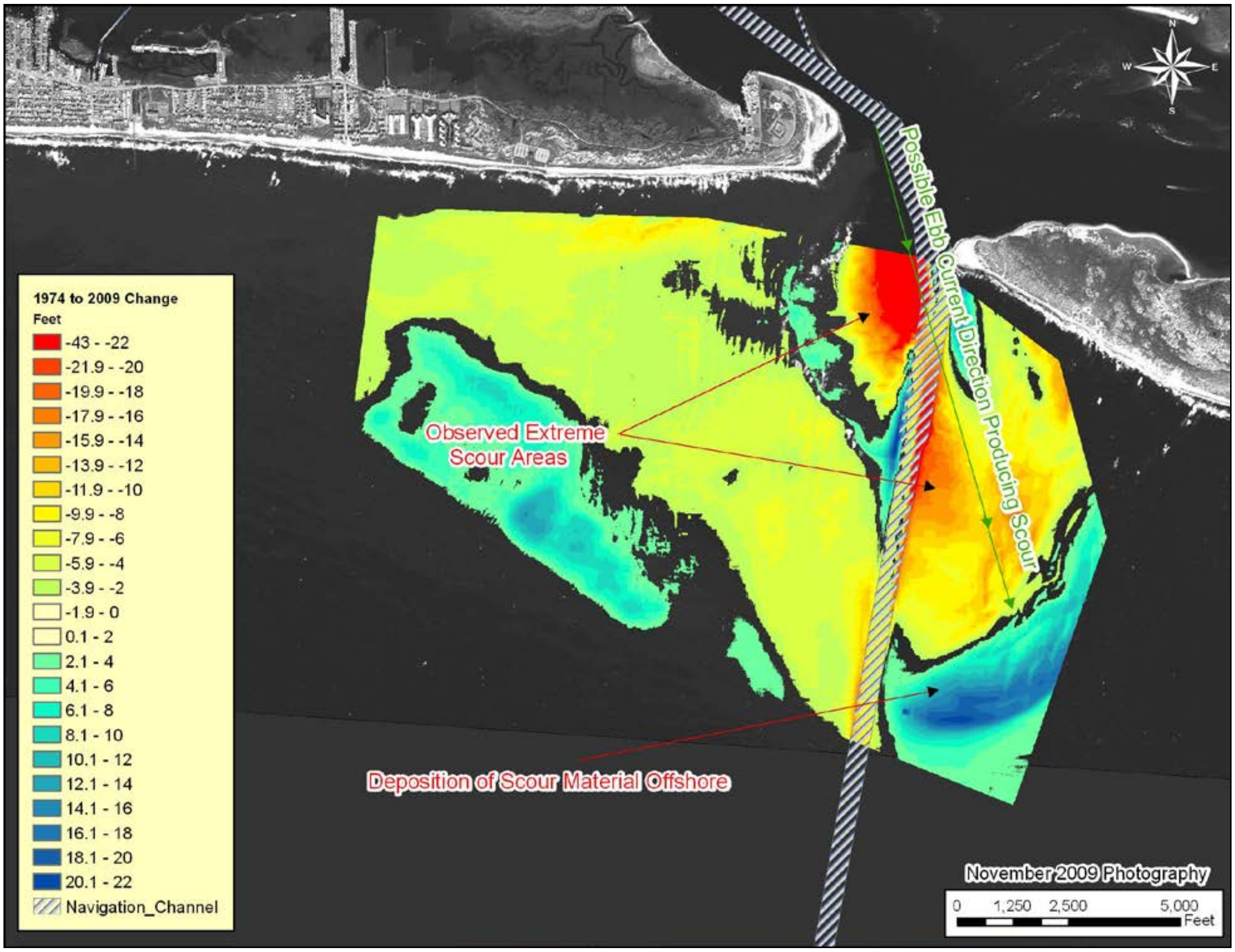


Figure 3-37. Elevation Difference Plot - 1974 to 2009

3.2.5.15 Reduce Channel Dimensions

Description: To reduce maintenance dredging costs for the Morehead City Harbor navigation channel, the PDT considered the option of narrowing or reducing the depth of the channel.

Issue: The 1992 Design Memorandum (USACE 1992), which addressed modifications to the Morehead City Harbor navigation channels, included several wideners to improve ongoing maintenance as part of the project that involved deepening from 40 to 45 feet in the interior channels. There were 3 wideners included in Range A, and the report states "These channel wideners are all needed with or without the project and are incrementally justified based on safety, economic considerations or both." Since wideners are needed, even at the 40-foot depth, narrowing the channel is not recommended.

The Navy/Marine Corps considers the Port of Morehead City a strategically critical site. Ideally, the Navy would prefer the Morehead City channel be widened to 600 feet (U. S. Navy 2002). This reinforces the requirement to retain existing channel widths.

Additionally, an analysis of vessel trips and drafts was done to determine channel utilization. Channel usage at a draft of 42 feet would require the authorized channel, and several vessels over the last few years have drafted about 42 feet.

Conclusion: Based on usage of the Port and its importance to the military, the option of reducing channel dimensions (width or depth) was eliminated from further consideration.

3.2.5.16 Construct Terminal Groin on Shackleford Banks

Description: One measure proposed by the public during DMMP development was the construction of a terminal groin on the west end of Shackleford Banks to help retain sand on Shackleford Banks.

Issue: In appropriate circumstances, terminal groins can work to the benefit of navigation projects. The impacts on adjacent beaches are often less certain to predict, and it can be a major undertaking to evaluate the potential effects of such projects on adjacent shorelines and the affected biotic communities. The major constraint preventing consideration of a terminal groin in the DMMP is Policy Guidance Letter (PGL) No. 40, which discusses the content and funding of DMMP efforts. Specifically, PGL No. 40 states that "management plan studies for existing projects shall be conducted pursuant to existing authorities for individual project operation and maintenance, as provided in public laws authorizing specific projects." Consideration of a new terminal groin would fall outside the existing authority for this DMMP. Specifically, such modification is not within the narrow range of navigation project modifications that would be exempt from congressional approval, as outlined in Engineer Regulation 1165-2-119. The PGL explains further that:

> "Studies of project modifications needing congressional authorization, including dredged material management requirements related to the modification, will be pursued as cost shared feasibility studies with General Investigations funding. Where the need for such modifications are identified as part of dredged material management studies, operation and maintenance funding for the study of the modification should be terminated and a new feasibility study start sought through the budget process under the authority of Section 216 of the Water Resources Development Act (WRDA) of 1970."

Terminal groins, jetties, and other potential navigation project modifications would appropriately be considered in a new feasibility study cost shared with the project sponsor, in this case the State of North Carolina, and not as part of a DMMP, which uses funds for Operation and Maintenance (O&M) of completed navigation projects. Initiation of a feasibility study to consider such modifications would require not only the concurrence of the cost-sharing sponsor, but also congressional authority to initiate the study using General Investigations (GI) funding.

Based on coordination with the National Park Service (NPS), it is also apparent that constructing a terminal groin on the east side of Beaufort Inlet as an alternative in the DMMP would likely be incompatible with National Park Service (NPS) policy. Section 4.8.1.1 of the 2006 NPS Management Policies pertains to shorelines and barrier islands. This section states that:

> "Natural shoreline processes (such as erosion, deposition, dune formation, overwash, inlet formation, and shoreline migration) will be allowed to continue without interference. Where human activities or structures have altered the nature or rate of natural shoreline processes, the Service will, in consultation with appropriate state and federal agencies, investigate alternatives for mitigating the effects of such activities or structures and for restoring natural conditions…"

The evaluation of a new terminal groin would not further the NPS policy of restoring natural processes and conditions nor would it likely be compatible with NPS wilderness policies, which permit management intervention to correct for human impacts, but only to the extent necessary and consistent with the minimum requirement concept (see, e.g., NPS Management Policies, Sections 6.3.5 and 6.3.7). A structure such as a terminal groin would not likely meet these protective criteria, particularly in light of funding limitations or other factors which may reduce the frequency and/or volume of sediment disposal.

Conclusion: Construction of a terminal groin on the west end of Shackleford Banks is both beyond the scope of this DMMP and is unlikely to be found compatible with NPS policies. Therefore, this option was eliminated from further consideration.

3.3 Costs of the Alternative Plans

Detailed cost estimates were developed for each of the DMMP measures and are included in Appendix G. Cost was a criterion used to develop a suite of DMMP measures that would provide adequate disposal capacity to maintain the Harbor to its fully authorized dimensions for at least the next 20 years. The estimates are detailed dredging estimates, except for dike raises, which were based on historic costs.

1. Cost Estimates were prepared under guidance given in the USACE Regulation ER 1110-2-1302, Civil Works Cost Engineering and EP 1110-1-8 Vol 3, Construction Equipment Ownership And Operating Expense Schedule.

2. The cost estimates are based on the January 2011 price level and current fuel prices as quoted by local distributors.

3. Dredging estimates were completed using the USACE Dredging Estimating Program (CEDEP) program.

a. CEDEP considers details of dredged material characteristics, depth of dredged material, effective production time, distances from dredge sites to disposal/placement sites, cost of dredge plant equipment, operating, and labor and other economic adjustments for fuel and area factors.

b. The location and features of dredge and disposal areas in relation to the channel ranges, as well as historical production, methods, and disposal considerations for similar projects, were used in conjunction with the CEDEP and Micro-Computer Aided Cost Estimating System (MCACES – MII) programs for determining dredging and construction costs.

c. Each measure includes general assumptions for that range or construction required.

d. All embankment construction soil material was assumed to be from on-site taken from the existing dry dredged material and surrounding island native soil.

e. An average 26% contingency was included to represent unanticipated conditions or uncertainties not known at the time of the estimate and was developed as referenced in ER 1110-2-1302 for this level of estimate. The 26% contingency was developed using the abbreviated Cost Schedule Risk Analysis approved by the USACE Cost Engineering Center of Expertise, Walla District.

4. Costs were evaluated over the 20 year planning period and were discounted at a federal discount rate of 4.000 % using the end-of-year convention. Present worth was determined using a factor of 0.07358 for the 20-year planning period and applicable interest rate. Additionally, screening level cost were presented in an average per cycle basis, while costs for the selected plan were presented as aggregate and average annual.

3.3.1 No Action Plan (No DMMP)

The "No Action" plan means status quo (continuation of the Interim Operations Plan indefinitely). The projected costs to implement the Interim Operations Plan are: Year 1 - $9 million, Year 2 - $5.9 million and year 3 - $3.8 million for a total of $18.7 million every 3 years. Assuming No DMMP, the IOP 3- year cycle would be repeated indefinitely subject to additional coordination. As shown in the tables below, the Interim Operations Plan costs are quite a bit lower than the proposed DMMP base plan. The main reason for this is that the IOP was designed to handle about 1 million cubic yards annually, which at the time was estimated to be the minimum volume required to be removed to keep the channel navigable (with only width restrictions). The primary difference in cost is due to the difference in volumes between minimum tolerances and the full channel maintenance envisioned by this DMMP. Also, the IOP does not include disposal of material on Shackleford Banks or in the ebb tide delta east of the Inlet. The average annual cost of the No Action Plan is about $6.4 million dollars and is shown by year in Table 3-11.

	Project Year	Cubic Yards	Annual Cost	Present Value
2015	1	1,100,000	$9,000,000	$8,653,846
2016	2	950,000	$5,900,000	$5,454,882
2017	3	850,000	$3,800,000	$3,378,186
2018	4	1,100,000	$9,000,000	$7,693,238
2019	5	950,000	$5,900,000	$4,849,370
2020	6	850,000	$3,800,000	$3,003,195
2021	7	1,100,000	$9,000,000	$6,839,260
2022	8	950,000	$5,900,000	$4,311,072
2023	9	850,000	$3,800,000	$2,669,830
2024	10	1,100,000	$9,000,000	$6,080,078
2025	11	950,000	$5,900,000	$3,832,527
2026	12	850,000	$3,800,000	$2,373,469
2027	13	1,100,000	$9,000,000	$5,405,167
2028	14	950,000	$5,900,000	$3,407,103
2029	15	850,000	$3,800,000	$2,110,005
2030	16	1,100,000	$9,000,000	$4,805,174
2031	17	950,000	$5,900,000	$3,028,902
2032	18	850,000	$3,800,000	$1,875,787
2033	19	1,100,000	$9,000,000	$4,271,782
2034	20	950,000	$5,900,000	$2,692,683
	Total Cost		$0	$86,735,555
	Average Annual Cost			$6,382,154

Table 3-11. Average Annual Costs of the No Action Plan

3.3.2 Proposed Measures

The costs per dredging cycle for each of the measures that comprise the base plan are discussed in the sections below. As demonstrated in the sections below, costs to implement the proposed base plan are considerably higher than the cost of the No Action plan (IOP). Unlike the IOP, the DMMP is based on maintaining the Harbor to its fully authorized dimensions, thus resulting in the annual removal of approximately 1.3 million cubic yards of dredged material. The DMMP also includes an option to place material on Shackleford Banks, which is not an option in the IOP. For simplicity, in the tables below, measures that are similar, such as placement of material in the Nearshore West and East, and whose costs are the same have been combined. Detailed costs for each individual measure are included in Appendix G, Cost Estimates. In the costs shown below in Tables 3-11 thru 3-16, the cost per cubic yard does not include mobilization and demobilization (mob and demob), but the costs per dredging cycle **do** include mob and demob. Following discussion of the costs for all measures considered is a summary of the cost of the recommended base plan (Section 3.3.3, Summary of Least Cost Analysis).

3.3.2.1 Brandt Island

Disposal of Material from the Northwest Leg, West Leg 1 and the East Leg. As shown in Figure 3-1, the Harbor ranges have been divided into three categories: 1) fine-grained material less than 80% sand, 2) material that is between 80% and 90% sand and 3) material that is greater than or equal to 90% sand. The Northwest Leg, a portion of the West Leg (referred to as West Leg 1) and the East Leg of the Inner Harbor contain fine-grained sediments (less than 80% sand) that may be disposed of in Brandt Island until it reaches capacity. Table 3-12 shows the costs for the viable measures considered for disposal of this material. Hopper dredges cannot work efficiently within confines of the Inner Harbor. This is especially true near the berths, therefore, hopper dredging here is not a viable option and costs are not included below. However, for comparison purposes, hopper dredge costs are included in the detailed cost estimates in Appendix G. As shown below, in this portion of the Inner Harbor, the cost for dredging with an 18-inch pipeline dredge on a three-year cycle, utilizing Brandt Island until it reaches capacity in 2028 would incur an average per cycle cost of approximately $744,000. Taking this material to the ODMDS (after Brandt Island reaches capacity in 2028) by bucket and barge would incur a cost of about $1,153,000.

Northwest Leg, West Leg 1, and East Leg					
ID #	**Disposal Area**	**Dredging Method**	**Quantity (CY)**	**Cost / CY**	**Average Cost per Cycle**
IH-1	Brandt Island	18-inch Pipeline	362,250	$4.34	$744,309
IH-2	ODMDS	Bucket and Barge	362,250	$7.07	$1,153,365

Table 3-12. Costs for Disposal from Northwest Leg, West Leg 1 & East Leg

Disposal of Material from the West Leg 2 and North Range C. Material from the West Leg 2 and North Range C contains a mix of fine-grained and coarse-grained material that is between 80% and 90% sand and therefore not suitable for beach disposal. However, this material is suitable for placement in the Nearshore West, the proposed Nearshore East, Brandt Island or in the ODMDS. The viable alternatives for disposal of material from the West Leg 2 and North Range C are listed below in Table 3-13.

West Leg 2 and North Range C					
ID #	**Disposal Area**	**Dredging Method**	**Quantity (CY)**	**Cost / CY**	**Average Cost per Cycle**
IH-12	Brandt Island	18" Pipeline	152,250	$4.30	$358,964
IH-17a	Nearshore West Existing New East	Bucket & Barge	152,250	$7.01	$525,954
IH-15a	Nearshore West (Expanded)	Bucket & Barge	152,250	$7.06	$529,152
IH-13	ODMDS	Bucket & Barge	152,250	$7.15	$534,907
IH-17	Nearshore West/East (Shallow)	Bucket & Barge	152,250	$7.41	$551,532

Table 3-13. Costs for Disposal from West Leg 2 & N. Range C

As shown in Table 3-13, the least cost dredging method is by 18-inch pipeline with disposal in Brandt Island at an average cost per cycle of about $359,000. The next most cost effective measure would be to dispose of this material in the Nearshore Placement Areas, via bucket and barge, at an average cost of approximately $526,000. However, for the relatively small amount of material in this area (152,250 cy), the most cost effective option is to combine this reach with the other Inner Harbor reaches and to use an 18-inch pipeline dredge with disposal in Brandt Island. Use of the ODMDS for this material is also an option as it would prolong the life of Brandt Island, however, it is not the least cost option.

Brandt Island Dike Raises and Expansion. Portions of Brandt Island contain fine-grained material that is not suitable for beach disposal. As a result of the lack of coarse-grained material in Brandt Island, future plans are to dispose of fine-grained material (only) there. Brandt Island is the least cost alternative for all of the Inner Harbor reaches. Prior to Brandt Island reaching capacity in 2028, the costs of expanding and raising the dikes to create additional capacity would be compared to the costs of alternative disposal methods, such as the ODMDS. Based on current projections, the Brandt Island dike could be expanded and raised to create capacity at an effective cost of about $1.70 per cubic yard (CY). This would add flexibility to the Harbor maintenance alternatives, which could save costs during future dredging events. Table 3-14 below shows costs for creating additional capacity in Brandt Island by expanding and raising the dike. The DMMP does not propose to raise or expand the Brandt Island dike at this time, but recommends investigating that option as Brandt Island reaches capacity.

Disposal Capacity on Brandt Island (Existing Capacity 2,977,434 CY)				
Brandt Island Dike Expansion and Raise				
Elevation	Quantity Required to Construct	Capacity Gained	Total Cost	Cost/CY
42 FT	442,157 CY	1,690,723 CY	$2,916,620	$1.73
47 FT	656,931 CY	2,506,497 CY	$4,180,335	$1.67
52 FT	917,100 CY	3,300,624 CY	$5,711,151	$1.73
55 FT	1,088,300 CY	3,771,856 CY	$6,718,479	$1.78

Table 3-14. Costs & Capacity Gained by Expanding & Raising Brandt Island Dike

3.3.2.2 Beach disposal

Disposal of Material from South Range C and North Range B. Material from South Range C and North Range B is coarse-grained material (greater than or equal to 90% sand) that should be kept in the littoral system by disposal on the beach or in the Nearshore West or East. Although this reach contains material comparable to that found in South Range B, the Cutoff and Range A out to Station 11+00, early in the planning process, this reach was separated from those reaches in order to evaluate the placement of this material in the nearshore areas in water depths of 25 feet or less (shallow). Table 3-15 provides quantities and average annual costs for the potentially viable alternatives considered for disposal of material from South Range C and North Range B. This coarse-grained material could also be disposed of on the beaches of Fort Macon State Park, Atlantic Beach and Shackleford Banks by 30-inch pipeline dredge at an average cost per cycle ranging from about $1,116,000 to $1,465,000. The least cost method of disposal is by use of a hopper dredge with placement of material in the Nearshore Placement Areas. The most cost effective means to handle this material is to combine maintenance of this reach with South Range B, the Cutoff and Range A out to station 110+00, reaches that require an ocean certified pipeline dredge. As another option, but at higher costs, this coarse-grained material could be handled with an 18-inch pipeline dredge inside the COLREGS line. COLREGS refer to the 1972 International Regulations for Preventing Collisions at Sea and COLREGS Lines of Demarcation were established by the Coast Guard to designate where "International Rules of the Road" separate from "U.S. Inland Rules". An 18-inch dredge must work inside the COLREGS line, whereas a 30-inch dredge is "ocean certified" and may also work outside in the Atlantic Ocean.

South Range C and North Range B (25% of Range B Shoal Quantity)					
ID #	**Disposal Area**	**Dredging Method**	**Quantity (CY)**	**Cost / CY**	**Average Cost per Cycle**
OH-5 or OH-7a	Nearshore West (Existing) or East	Hopper	346,350	$4.23	$730,825
OH-5a	Nearshore West (Expanded)	Hopper	346,350	$4.52	$773,011
OH-7 or OH-5b	Nearshore West/East (Shallow)	Hopper	346,350	$5.14	$863,200
OH-4 or OH-6a	Nearshore West (Existing) or East	Bucket & Barge	346,350	$6.96	$1,090,150
OH-4a	Nearshore West (Expanded)	Bucket & Barge	346,350	$7.01	$1,097,424
OH-9	Beach Disposal (Bogue Banks)	30" Pipeline	346,350	$6.50	$1,116,476
OH-6 or OH-4b	Nearshore West/East (Shallow)	Bucket & Barge	346,350	$7.34	$1,145,428
OH-11	Beach Disposal (Shackleford Banks)	30" Pipeline	346,350	$7.05	$1,196,482
OH-9a or OH-11a	Nearshore West/East	30" Pipeline	346,350	$8.80	$1,464,910
OH-8	Beach Disposal (Bogue Banks)	18" Pipeline	346,350	$8.20	$1,822,829
OH-10	Beach Disposal (Shackleford Banks)	18" Pipeline	346,350	$9.71	$2,042,485
OH-11b	Nearshore West /East	18" Pipeline	346,350	$11.14	$2,250,502

Table 3-15. Costs for Disposal of Material from South Range C and North Range B

Disposal of Material from South Range B, the Cutoff and Range A out to Station 110+00. Material in this Range is coarse-grained material (greater than or equal to 90% sand) that may be placed on the beach or in the Nearshore West or East. Table 3-16 provides quantities and average cost per cycle for the alternatives that could potentially draw material from this area. This portion of the Harbor requires dredging on an annual basis. Because of the increased frequency of dredging, the cost per cubic yard increases with annual activity, as shown in Appendix G. Typically this material has been disposed of on the beach during the first year of the 3-year maintenance cycle and in the Nearshore West in years 2 and 3 of the cycle. Under the assumption that this practice will continue (with the addition of use of the Nearshore East), the least cost option would be to use a hopper dredge with placement of material in the Nearshore West and East, every second and third year. Disposal of this material on the beaches of Fort Macon State Park, Atlantic Beach and Shackleford Banks by 30-inch pipeline dredge would incur an average cost per cycle of approximately $14,408,000. Although this cost is relatively high, the disposal of dredged material on the beaches would offset potential impacts to the adjacent beaches (a function previously performed on Bogue Banks by recycling sand from Brandt Island). The least cost disposal option for this material is use of a hopper dredge with placement in the Nearshore Placement Areas. The average cost per cycle of this option ranges from about $4,879,000 to $5,783,000. A bucket and barge could also be used in this area, but at higher costs. Another measure considered for beach disposal is a hopper pump-out, however, that cost is the highest of all potentially viable measures considered.

South Range B, Cutoff, North Range A out to Station 110+00					
ID #	**Disposal Area**	**Dredging Method**	**Quantity (CY)**	**Cost / CY**	**Average Cost per Cycle**
OH-16 or OH-18a	Nearshore West (Existing) or East	Hopper	886,050	$4.06	$4,879,177
OH-16a	Nearshore West (Expanded)	Hopper	886,050	$4.34	$5, 191,776
OH-16b or OH-18	Nearshore West/East (Shallow)	Hopper	886,050	$4.87	$5, 783,480
OH-15 or OH-17a	Nearshore West (Existing) or East	Bucket & Barge	886,050	$7.24	$8, 775,903
OH-15a	Nearshore West (Expanded)	Bucket & Barge	886,050	$7.47	$9,032,680
OH-15b or OH-17	Nearshore West/East (Shallow)	Bucket & Barge	886,050	$8.20	$9,847,669
OH-19 or OH-21	Beach Disposal (Shackleford and Bogue Banks)	30” Pipeline	886,050	$8.73	$14,408,373
OH-19a or OH-21a	Nearshore West/East	30” Pipeline	886,050	$9.61	$15,768,825
OH-20 or OH-22	Beach Disposal (Shackleford and Bogue Banks)	Hopper Pumpout	886,050	$10.16	$12, 533,558

Table 3-16. Costs for Disposal of Material from South Range B, Cutoff, North Range A out to Station 110+00

3.3.2.3 Ocean Dredged Material Disposal

Disposal of Material from Range A seaward of Station 110+00. Material from Range A seaward of station 110+00 is fine-grained material that is in close proximity to the ODMDS and as such, should be disposed of in the ODMDS. Table 3-17 provides quantities and average annual costs of the alternatives which could potentially draw material from South Range A seaward of station 110+00. The least cost option is by hopper dredge at an average cost per cycle of about $620,000. Hopper dredges are even more cost effective when ranges are combined into a single contract. Technically, material from anywhere in the Harbor could be disposed of in the ODMDS, with fine-grained and coarse-grained material segregated to allow efficient removal of material for future beach disposal.

South Range A Seaward of Station110+00					
ID #	**Disposal Area**	**Dredging Method**	**Quantity (CY)**	**Cost / CY**	**Average Cost per Cycle**
OEC3	ODMDS from 110+00 Outward	Hopper	343,500	$3.50	$620,445
OEC2	ODMDS from 110+00 Outward	Bucket & Barge	343,500	$6.36	$1,033,057

Table 3-17. Costs for Disposal of Material from South Range A Seaward of Station110+00

3.3.2.4 Ebb Tide Delta Placement

Disposal of Material from South Range C and North Range B. Material from South Range C and North Range B is coarse-grained (greater than or equal to 90% sand) that could be placed in the Nearshore Placement Areas or on the adjacent beaches. Table 3-15, above, provides quantities and average annual costs for the potentially viable alternatives considered for disposal of material from South Range C and North Range B. The least cost method of disposal is by use of a hopper dredge with placement of material in the Nearshore Placement Areas. Depending on the exact placement location, cost per cycle range from about $730,000 to $863,000. This material may also be placed in the existing Nearshore Placement Areas by bucket and barge at a cost per cycle ranging from about $1,100,000 to $1,150,000. This placement of material within the ebb tide delta would help reduce sediment losses in the ebb tide delta.

Disposal of Material from South Range B, the Cutoff and Range A out to Station 110+00. Material from Range B, the Cutoff and Range A out to Station 110+00 is coarse-grained material (greater than or equal to 90% sand) that may also be placed in the ebb tide delta or on the adjacent beaches. Table 3-16, above, provides quantities and average annual costs for the measures considered for South Range B, the Cutoff and Range A out to Station 110+00. The least cost disposal option for this material is use of a hopper dredge with placement in the Nearshore Placement Areas (ebb tide delta). Depending on the placement location within the ebb tide delta, costs per cycle range from about $4,879,000 to $5,783,000. A bucket and barge could also be used in this area for ebb tide delta placement, but at higher costs. The other measure recommended as part of the base plan is disposal of this material on the adjacent beaches, as discussed above. One other measure considered the use of a 30-inch pipeline dredge, however that cost is the highest of all measures considered for placement in the ebb tide delta.

3.3.3 Summary of Least Cost Analysis

The DMMP assumes that the navigation channel will be maintained to the fully authorized dimensions. The proposed disposal plan provides for disposal of coarse-grained material (greater than or equal to 90% sand) on the beaches of Fort Macon State Park, Atlantic Beach and Shackleford Banks every three years, with fine-grained material being disposed of in Brandt Island or the ODMDS. Material that is predominantly sand (greater than or equal to 80% sand) would be placed in the Nearshore West and Nearshore East in years when beach disposal does not occur. As shown in Table 3-18, this plan would have an average annual cost of $11,925,401.

	Project Year		Annual Cost	Present Value
2015	1		$17,682,510	$17,002,413
2016	2		$6,798,244	$6,285,359
2017	3		$10,933,946	$9,720,238
2018	4		$17,682,510	$15,115,084
2019	5		$6,798,244	$5,587,661
2020	6		$10,933,946	$8,641,256
2021	7		$17,682,510	$13,437,254
2022	8		$6,798,244	$4,967,410
2023	9		$10,933,946	$7,682,045
2024	10		$17,682,510	$11,945,670
2025	11		$6,798,244	$4,416,010
2026	12		$10,933,946	$6,829,310
2027	13		$17,682,510	$10,619,657
2028	14		$6,798,244	$3,925,817
2029	15		$14,199,841	$6,071,232
2030	16		$17,682,510	$9,440,837
2031	17		$6,798,244	$3,490,037
2032	18		$14,199,841	$5,397,303
2033	19		$17,682,510	$8,392,869
2034	20		$6,798,244	$3,102,630
	Total Cost			$162,070,093
	Average Annual Cost			$11,925,401

Table 3-18. DMMP Average Annual Costs

A summary of the least cost analysis is shown in Tables 3-19 and 3-20 below. As presented in Table 3-19, the maintenance dredging costs can be divided by areas and projected by year using historic dredging records and future expectations. Costs to maintain Morehead City Harbor are increasing, principally because the costs to manage Brandt Island and to place material on adjacent beaches are higher than historic costs. Also, the DMMP anticipates dredging about 1.3 million cubic yards of material each year, higher than the historic amount of approximately 1 million cubic yards per year. By estimating the costs of this larger volume of material, expected costs are higher than historic costs. Also, all cost estimates include a contingency of 26%, which would not be included in historic costs.

The expected average annual cost to implement the DMMP for the operation and maintenance of Morehead City Harbor is given in the table below. These costs are in

Fiscal year 2011 price level (January 2011) at an interest rate of 4.000% for a twenty year period from 2015 through 2034 and do not contain costs for Planning, Engineering and Design (PED), monitoring, or Supervisory and Administrative (S&A) costs. Table 3-20 provides a more detailed cost summary of the 20-year plan, including Monitoring, PED and S & A costs.

Year of 3-yr cycle	**Location**	**Costs per Cycle**
1	Beaches	$ 16,405,200
2	Nearshore East and West	$ 5,903,730
3	Brandt Island (2015-2028)	$ 3,311,658
3	Nearshore East and West	$4,530,960
3	ODMDS	$ 1,863,540
3	ODMDS (2029- until/ after Brandt Island is full)	$8,441,093

Table 3-19. Summary of Average Annual Costs by Disposal/Placement Location

Year	Brandt Island	Nearshore East and West	Beaches	ODMDS	Monitoring PED, S&A	Total Cost	Present Value
2015			$16,405,200		$1,277,310	$17,682,510	17,002,413
2016		$5,903,730			$894,514	$6,798,244	6,285,359
2017	$3,311,658	$4,530,960		$1,863,540	$1,227,788	$10,933,946	9,720,238
2018			$16,405,200		$1,277,310	$17,682,510	15,115,084
2019		$5,903,730			$894,514	$6,798,244	5,587,661
2020	$3,311,658	$4,530,960		$1,863,540	$1,227,788	$10,933,946	8,641,256
2021			$16,405,200		$1,277,310	$17,682,510	13,437,254
2022		$5,903,730			$894,514	$6,798,244	4,967,410
2023	$3,311,658	$4,530,960		$1,863,540	$1,227,788	$10,933,946	7,682,045
2024			$16,405,200		$1,277,310	$17,682,510	11,945,670
2025		$5,903,730			$894,514	$6,798,244	4,416,010
2026	$3,311,658	$4,530,960		$1,863,540	$1,227,788	$10,933,946	6,829,310
2027			$16,405,200		$1,277,310	$17,682,510	10,619,657
2028		$5,903,730			$894,514	$6,798,244	3,925,817
2029		$4,530,960		$8,441,093	$1,227,788	$14,199,841	6,071,232
2030			$16,405,200		$1,277,310	$17,682,510	9,440,837
2031		$5,903,730			$894,514	$6,798,244	3,490,037
2032		$4,530,960		$8,441,093	$1,227,788	$14,199,841	5,397,303
2033			$16,405,200		$1,277,310	$17,682,510	8,392,869
2034		$5,903,730			$894,514	$6,798,244	3,102,630
Total Costs	$13,246,632	$68,511,870	$114,836,400	$24,336,346	$22,569,498	$243,500,746	$162,070,093
						Average Annual Cost	$11,925,401

Table 3-20. Year by Year Cost Summary of the Proposed Base Plan

The Harbor at Morehead City is compact and includes about three miles of interior channels from the Port facility to Beaufort Inlet and about four miles from the Inlet out to naturally deep water in the open ocean. Due to the relatively short distances covered by the Morehead City Harbor navigation channel, dredging equipment working in one range of the Harbor may cost effectively work in other ranges, even if it does not appear to be least cost. Since costs per cubic yard for most ranges of the Harbor are similar and mobilization costs are very high, equipment that can be mobilized for multiple ranges is very advantageous. Also, mobilization of equipment for Morehead City Harbor may be done in conjunction with Wilmington Harbor or the Atlantic Intracoastal Waterway (AIWW) to further reduce costs to each project. The proposed DMMP, which is described in detail below, attempts to provide flexibility and interoperability thus allowing innovative proposals to accomplish the maintenance dredging at the least possible cost while minimizing impacts of the navigation project.

3.4 Proposed Base Plan (DMMP)

The sections below provide a summary of the process used to analyze and screen alternatives (Trade-Off Analysis), a detailed description of the proposed 20-year base plan and real estate requirements associated with the base plan.

3.4.1 Trade-Off Analysis

The recommended base plan for the Morehead City Harbor DMMP was developed through a plan formulation process that incorporated knowledge gained over the past several decades of maintaining the Morehead City Harbor navigation channels. Specifically, development of the recommended base plan was based on dredging methods and costs, disposal options, sediment quality data, analysis of the physical and natural environment within the study area and coordination with stakeholders and resource agencies. As presented in Tables 3-20 thru 3-24, below, a variation of the direct scoring method, also called the “Borda” method (Pomerol and Barba-Romero 2000), was used to inform the process of selecting the base plan. Tables 3-20 thru 3-24 demonstrate the trade-offs considered in the development of the base plan for the DMMP. For each DMMP measure evaluated, trade-offs with respect to five criteria were considered. The five criteria are dredged material disposal/placement capacity, environmental acceptability, operational viability, beneficial uses, and cost. Rankings of various criteria were summed for all measures considered in the development of the base plan. Scores were assigned for each criterion ranging from 1 (worst) to 5 (best), as described below.

Disposal or Placement Capacity. Each DMMP measure was evaluated for the dredged material disposal or placement capacity that it provides over the life of the DMMP (20 years). The ranking below does not identify specific dredged material quantities for each rank because required capacities vary widely within the various sections of the Morehead City Harbor navigation project. Also, dredged material disposal sites such as the 8-square mile ODMDS and local beaches have virtually unlimited capacity.

5 – Site has capacity beyond the 20-year life of the DMMP
4 – Site has capacity sufficient for at least the next 20 years
3 – Site has capacity sufficient for at least the next 10 years
2 – Site provides slightly greater capacity than that required for one dredging event
1 – Site does not provide sufficient capacity for one dredging event

Environmental Acceptability. This criterion considers the environmental acceptability of a measure being evaluated and includes consideration of regulatory or permitting issues and views by resource agencies.

5 – No environmental issues regarding this option exist and/or site is already permitted for disposal or placement of dredged material

4 – Site is not currently approved for disposal or placement of material, however, obtaining approval from resource agencies is not likely an issue
3 – Some resource agencies may favor this option while others may not and/or site is not currently approved for disposal or placement of dredged material however, obtaining approval should not prove difficult
2 – Some resource agencies may favor this option while others would not and/or site is not currently approved for disposal or placement of dredged material and obtaining approval would prove difficult
1 – Resource agencies are strongly opposed to this option and/or site is not approved for disposal/placement of dredged material and likely would not be in the future

Operational Viability. This criterion evaluates the operational viability of the various measures considered by taking into account the type of dredge plant used within the various ranges of the Harbor and the characteristics of the material being dredged.

5- This is the preferred mode of operation
4- This is not the preferred mode of operation, but is operationally feasible
3- This is not the preferred mode of operation and is marginal operationally
2- This is not the preferred mode of operation and is not operationally feasible
1- This option is not operationally possible

Beneficial Uses. Each DMMP measure was evaluated based on its level of beneficial use. This criterion considered the beneficial uses associated with reducing impacts of the navigation project on adjacent beaches and the ebb tide delta. This criterion also takes into account potential beneficial uses for environmental purposes including fish and wildlife habitat creation, ecosystem restoration and enhancement, and coastal storm damage reduction.

5 – Beneficial use that successfully offsets potential impacts from the navigation project (beaches and ebb tide delta).
4 – Beneficial use that reduces potential impacts from the navigation project (beaches and ebb tide delta), but to a lesser degree than those rated 5.
3 – Beneficial use that does not reduce impacts from the navigation channel, but which has the potential to provide wildlife habitat and ecosystem restoration and/or enhancement
2 – Marginal beneficial use
1 – Not a beneficial use

Cost. This criterion considers the relative average annual costs of the measures considered. Costs are simply in rank order with a rank of 5 being the least cost measure and other costs ranked relative to the least cost as follows.
5 – Least cost
4 – Next highest cost relative to least cost
3 – Next highest cost relative to measures ranked as 4
2 – Next highest cost relative to measures ranked as 3
1 – Highest cost

The following pages include the summary of the trade-off analysis for DMMP measures considered during development of the recommended base plan. Each of the tables below addresses a particular channel range within the Harbor. Channel ranges were identified based on their location within the Harbor and the sediment characteristics of material typically dredged from those areas. All five screening criteria were considered for every potential measure evaluated, however, measures that received a score of 1 for disposal capacity, environmental acceptability, or operational viability were eliminated from further consideration and costs were not computed for the majority of those particular measures. In some cases, costs were computed only for comparison purposes. As shown in Tables 3-20 thru 3-24, although several options are available for some of the Harbor ranges, the proposed base plan includes only those measures highlighted in blue. Considering all trade-offs, these measures provide the best balance between least cost, sound engineering, and environmental acceptability. The intent of the DMMP is to remain flexible, therefore, any of the high ranking measures could be implemented in the future. However, costs for the 20-year plan were based on those measures highlighted in blue. Following each table is an explanation of the logic used in selecting the recommended base plan.

Inner Harbor (IH) - Northwest Leg, West Leg 1 and East Leg - sediments < 80% sand									
Measure ID#	**Dredging Method**	**Disposal/Placement Area**	**Disposal or Placement Capacity (1-5)**	**Environmental Acceptability (1-5)**	**Operational Viability (1-5)**	**Beneficial Use (1-5)**	**Cost (1-5)**	**Excluded**	**Total Score**
IH-1	18-inch pipeline	Brandt Island	3	5	5	1	5		19
IH-2	bucket & barge	ODMDS	5	5	5	1	4		20
IH-3	hopper	ODMDS	5	5	1	1		X	
IH-4	bucket & barge	Nearshore West	4	1	1	4		X	
IH-5	hopper	Nearshore West	4	1	1	4		X	
IH-6	bucket & barge	Nearshore East	4	1	5	4		X	
IH-7	hopper	Nearshore East	4	1	1	4		X	
IH-8	18-inch pipeline	Ft. Macon / Atlantic Beach	5	1	4	1		X	
IH-9	30-inch pipeline	Ft. Macon / Atlantic Beach	5	1	4	1		X	
IH-10	18-inch pipeline	Shackleford Banks Beach	5	1	4	1		X	
IH-11	30-inch pipeline	Shackleford Banks Beach	5	1	4	1		X	
IH-A	18-inch pipeline	Marsh Island or Radio Island	1	5	5	1		X	
IH-B	varies	Modify Environmental Windows	NA	1	NA	NA		X	
IH-C	18-inch pipeline	Construct Waterbird Islands	2	2	1	1		X	
IH-D	18-inch pipeline	Create Wetlands	1	3	3	3	3		13
IH-E	varies	Construct New Upland Disposal Site	1	4	4	1		X	
IH-F	varies	Brandt Island Shoreline Stabilization	NA	3	NA	2		X	
IH-G	varies	Reduce Channel Dimensions	NA	5	1	NA		X	

Measure	Reason(s) For Elimination
IH-3, IH-5, IH-7	Use of a hopper dredge in the Inner Harbor is not operationally viable
IH-4 thru IH-7	Not preferable to place fine-grained material in the nearshore
IH-8 thru IH-11	Sediments not suitable for beach disposal
IH-A and IH-D	Does not provide enough capacity for a single dredging event
IH-B	Modifying environmental windows would not benefit long-term management
IH-C	- Fine-grained material not suitable habitat for waterbird nesting - Constructing an island with fine-grained material is not operationally viable
IH-E	No undeveloped uplands exist in the project vicinity
IH-F	An analysis was performed to determine if stabilizing the north shoreline of Brandt Island would decrease shoaling within the Harbor (Section 3.2.5.12). Due to the limited change observed during this analysis, a shoreline stabilization measure was not evaluated further.
IH-G	Current commercial/military navigation traffic requires the full channel dimensions.

Table 3-21. Screening of Measures for Maintenance of the Northwest Leg/West Leg 1 & East Leg (sediments less than 80% sand)

As shown in Table 3-21, measures IH-1 and IH-2 are the only feasible options for disposal of material from the Northwest Leg, West Leg 1 and the East Leg. Due to the fine-grained nature of these sediments, disposal options are limited to Brandt Island (IH-1) and the ODMDS (IH-2).

The Brandt Island pipeline dredge option (IH-1) costs essentially the same as mechanical dredging with disposal in the ODMDS, however, one advantage of using Brandt Island is that maintenance dredging contracts for the Morehead City Harbor project are usually grouped with contracts for maintenance dredging of the AIWW (pipeline dredging), resulting in cost savings for both projects. This cost savings is quite variable and therefore was not included in the cost calculations for the IH-1 alternative, but it is an important trade-off and the reason that IH-1 received a more favorable rating on cost than IH-2. The Brandt Island capacity is much more limited than the ODMDS, resulting in a lower capacity score for Brandt Island. Based on the trade-off analysis, the recommended plan for maintenance of the fine-grained material in the Inner Harbor is use of an 18-inch pipeline with disposal in Brandt Island until it reaches capacity in

2028. As Brandt Island nears capacity, the District will evaluate the option of dike expansion and dike raises as compared to the costs of taking this Inner Harbor material to the ODMDS.

Inner Harbor (IH) - West Leg 2 & North Range C - sediments at least 80% sand									
Measure ID#	Dredging Method	Disposal/Placement Area	Disposal or Placement Capacity (1-5)	Environmental Acceptability (1-5)	Operational Viability (1-5)	Beneficial Use (1-5)	Cost (1-5)	Excluded	Total Score
IH-12	18-inch pipeline	Brandt Island	4	5	5	1	5		20
IH-13	bucket & barge	ODMDS	5	5	4	1	3		18
IH-14	Hopper	ODMDS	5	5	1	1		X	
IH-15	bucket & barge	Nearshore West-shallow	4	4	4	5	3		20
IH-15a	bucket & barge	Nearshore West- expanded	4	4	4	4	4		20
IH-15b	bucket & barge	Nearshore West- existing	4	4	4	4	4		20
IH-16	Hopper	Nearshore West -shallow	4	4	1	5		X	
IH-16a	Hopper	Nearshore West -expanded	4	4	1	4		X	
IH-16b	Hopper	Nearshore West -existing	4	4	1	4		X	
IH-17	bucket & barge	Nearshore East- shallow	4	4	5	5	3		21
IH-17a	bucket & barge	Nearshore East	4	4	5	4	4		21
IH-18	Hopper	Nearshore East - shallow	4	4	1	5		X	
IH-18a	Hopper	Nearshore East	4	4	1	4		X	
IH-19	18-inch pipeline	Ft. Macon / Atlantic Beach	5	1	4	1		X	
IH-20	30-inch pipeline	Ft. Macon / Atlantic Beach	5	1	5	1		X	
IH-21	18-inch pipeline	Shackleford Banks Beach	5	1	4	1		X	
IH-22	30-inch pipeline	Shackleford Banks Beach	5	1	5	1		X	
IH-23	30-inch Pipeline	Nearshore West	4	4	5	4	3		20
IH-24	30-inch Pipeline	Nearshore East	4	4	5	4	3		20
IH-25	18-inch Pipeline	Nearshore West or East	4	4	5	4	2		19
IH-A	18-inch pipeline	Marsh Island or Radio Island	1	5	5	1		X	
IH-B	varies	Modify Environmental Windows	NA	1	NA	NA		X	
IH-C	18-inch Pipeline	Construct Waterbird Islands	2	2	1	3	1		9
IH-D	18-inch Pipeline	Create Wetlands	1	4	3	4		X	
IH-E	varies	Construct New Upland Disposal Site	1	4	4	1		X	
IH-F	varies	Brandt Island Shoreline Stabilization	NA	3	NA	2		X	
IH-G	varies	Reduce Channel Dimensions	NA	5	1	NA		X	

Measure	Reason(s) Measure Eliminated
IH-14, IH-16, 16a,16b, IH-18 and 18a	Use of hopper dredge in Inner Harbor not operationally feasible
IH-19 thru IH-22	Sediments not suitable for beach disposal
IH-A, IH-C and IH-D	Does not provide enough capacity for a single dredging event
IH-B	Modifying environmental windows would not benefit long-term management
IH-E	No undeveloped uplands exist in the project vicinity
IH-F	An analysis was performed to determine if stabilizing the north shoreline of Brandt Island would decrease shoaling within the Harbor. Due to the limited change observed during this analysis, a shoreline stabilization measure was not evaluated further.
IH-G	Current commercial/military navigation traffic requires the full channel dimensions

Table 3-22. Screening of Measures for Maintenance of the West Leg 2 & N. Range C.

The West Leg 2 and North Range C contain sediments that are between 80% and 90% sand. As shown in Table 3-22, these sediments may be disposed of in Brandt Island (IH-12), the ODMDS (IH-13), the Nearshore West (IH-15 thru IH-16) or the Nearshore East (IH-17 and IH-17a). Although several measures have the same score, the most cost-effective alternative that is environmentally acceptable and operationally feasible is use of an 18-inch pipeline dredge with disposal in Brandt Island. However, use of a pipeline dredge with a spider barge, bucket and barge, and/or direct placement by pipeline dredge in the nearshore are potential options. The Nearshore placement provides the only potential for beneficial use of this material by keeping the dredged material “in the system,” however, it is inefficient to mobilize a separate dredge (bucket and barge) for the small amount of material in this range - about 152,000 cubic yards every three years. It is much more efficient to combine this reach with the other Inner Harbor reaches and to use a pipeline dredge with disposal in Brandt Island. Therefore, for the West Leg 2 and North Range C, the recommended base plan is use of an 18-inch pipeline dredge with disposal in Brandt Island until it reaches capacity in 2028. As Brandt Island nears capacity, the District will reevaluate the option of taking this material to the Nearshore Placement Areas, expanding and raising the Brandt Island dike, or disposing of this material in the ODMDS.

Outer Harbor (OH) - South Range C & North Range B - sediments ≥ 90% sand									
Measure ID#	Dredging Method	Disposal/Placement Area	Disposal or Placement Capacity (1-5)	Environmental Acceptability (1-5)	Operational Viability (1-5)	Beneficial Use (1-5)	Cost (1-5)	Excluded	Total Score
OH-1	18-inch Pipeline	Brandt Island	2	1	5	1		X	
OH-2	Bucket & Barge	ODMDS	5	4	5	1		X	
OH-3	Hopper	ODMDS	5	4	5	1		X	
OH-4	Bucket & Barge	Nearshore West (existing)	3	5	5	4	4		21
OH-4a	Bucket & Barge	Nearshore West (expanded)	4	5	5	4	4		22
OH-4b	Bucket & Barge	Nearshore West (expanded shallow)	4	5	4	5	4		22
OH-5	hopper	Nearshore West (existing)	4	5	5	4	5		23
OH-5a	hopper	Nearshore West (expanded)	4	4	5	4	5		22
OH-5b	hopper	Nearshore West (expanded shallow)	4	4	4	5	5		22
OH-6	Bucket & Barge	Nearshore East (shallow)	3	4	4	5	4		20
OH-6a	Bucket & Barge	Nearshore East	4	4	5	4	4		21
OH-7	Hopper	Nearshore East (shallow)	4	4	4	5	5		22
OH-7a	Hopper	Nearshore East	4	4	5	4	5		22
OH-8	18-inch pipeline	Ft. Macon / Atlantic Beach	5	5	4	5	2		21
OH-9	30-inch pipeline	Ft. Macon / Atlantic Beach	5	5	5	5	4		24
OH-9a	30-inch Pipeline	Nearshore West (anywhere)	5	4	5	4	3		21
OH-10	18-inch pipeline	Shackleford Banks Beach	5	4	4	5	2		20
OH-11	30-inch pipeline	Shackleford Banks Beach	5	4	5	5	4		23
OH-11a	30-inch Pipeline	Nearshore East	5	4	5	4	3		21
OH-11b	18-inch Pipeline	Nearshore East or West	5	4	5	4	2		20
OH-A	18-inch pipeline	Marsh Island or Radio Island	1	1	5	2		X	
OH-B	Varies	Modify Environmental Windows	NA	1	NA	NA		X	
OH-C	18-inch pipeline	Construct Waterbird Islands	2	3	4	3	1		13
OH-D	18-inch pipeline	Create Wetlands	1	2	3	2		X	
OH-E	varies	Construct New Upland Disposal Site	1	4	4	1		X	
OH-F	varies	Brandt Island Shoreline Stabilization	NA	3	NA	2		X	
OH-G	varies	Reduce Channel Dimensions	NA	5	1	NA		X	

Measure	Reason(s) Measure Eliminated
OH-1, OH-2 and OH-3	Removes coarse-grained sediments(≥90% sand) from littoral system
OH-A, OH-C and OH-D	Does not provide enough capacity for a single dredging event
OH-B	Modifying environmental windows would not benefit long-term management
OH-E	- No undeveloped uplands exist in the project vicinity - Removes coarse-grained sediments(≥90% sand) from littoral system
OH-F	An analysis was performed to determine if stabilizing the north shoreline of Brandt Island would decrease shoaling within the Harbor. Due to the limited change observed during this analysis, a shoreline stabilization measure was not evaluated further.
OH-G	Current commercial navigation traffic requires the full channel dimensions

Table 3-23. Screening of Measures for Maintenance of South Range C and North Range B.

As shown in Table 3-23, there are several potentially viable options for the disposal of coarse-grained sediments (≥90% sand) from South Range C and North Range B. For these measures, capacity, environmental acceptability and operational viability varied very little. The determining screening criteria were beneficial use and cost. All of the potential options beneficially use the dredged material, however, those options that would result in material being disposed of directly on the beach or in the active littoral zone (Nearshore West shallow) received the highest scores. Trade-offs are comparable between use of a mechanical dredge with placement in either Nearshore

Placement Area (OH-4, 4a, 4b and OH-6) and use of a 30-inch pipeline dredge with disposal of material on the beaches of Fort Macon State Park and Atlantic Beach (OH-9) or on Shackleford Banks (OH-11), therefore all of the measures highlighted in blue are viable and are included on a rotational basis in the proposed base plan. In year 1 of the 3-year cycle, material from this range will be disposed of on the adjacent beaches and in years 2 and 3, material will be placed in the Nearshore Placement Areas. Although costs to place material in water depths less than 25 feet deep are somewhat greater than costs to place the material in deeper water, when appropriate dredge equipment is available, a concerted effort will be made to place the material within the shallow depths (less than 25 feet) of the Nearshore Placement Areas.

Outer Harbor (OH) - South Range B , Cutoff, North Range A to sta. 110+00 - sediments ≥ 90% sand									
Measure ID#	Dredging Method	Disposal/Placement Area	Disposal or Placement Capacity (1-5)	Environmental Acceptability (1-5)	Operational Viability (1-5)	Beneficial Use (1-5)	Cost (1-5)	Excluded	Total Score
OH-12	18-inch Pipeline	Brandt Island	2	1	4	1		X	
OH-13	Bucket & Barge	ODMDS	5	4	2	1	4		16
OH-14	Hopper	ODMDS	5	4	5	1	5		20
OH-15	Bucket & Barge	Nearshore West-Existing	4	5	2	4	4	X	19
OH-15a	Bucket & Barge	Nearshore West-expanded	4	5	2	4	4	X	19
OH-15b	Bucket & Barge	Nearshore West-shallow	4	5	2	5	3	X	19
OH-16	hopper	Nearshore West (existing)	4	5	5	4	5		23
OH-16a	hopper	Nearshore West (expanded)	4	5	5	4	5		23
OH-16b	hopper	Nearshore West (expanded shallow)	4	5	4	5	5		23
OH-17	Bucket & Barge	Nearshore East-shallow	4	4	2	5	3	X	18
OH-17a	Bucket & Barge	Nearshore East	4	4	2	4	4	X	18
OH-18	Hopper	Nearshore East-shallow	4	4	4	5	5		22
OH-18a	Hopper	Nearshore East	4	5	5	4	5		23
OH-19	30-inch pipeline	Ft. Macon / Atlantic Beach	5	5	5	5	4		24
OH-19a	30-inch Pipeline	Nearshore West	4	4	5	4	2		19
OH-20	Hopper (pump-out)	Ft. Macon / Atlantic Beach	5	5	4	5	1		20
OH-21	30-inch Pipeline	Shackleford Banks Beach	5	4	5	5	4		23
OH-21a	30-inch Pipeline	Nearshore East	4	4	5	4	2		19
OH-22	Hopper (pump-out)	Shackleford Banks Beach	5	4	4	5	1		19
OH-A	30-inch pipeline	Brandt Island	2	5	4	1		X	
OH-B	30-inch pipeline	Marsh Island or Radio Island	1	5	2	1		X	
OH-C	varies	Modify Environmental Windows	NA	1	NA	NA		X	
OH-D	30-inch pipeline	Construct Waterbird Islands	1	3	4	3		X	
OH-E	30-inch pipeline	Create Wetlands	1	2	3	2		X	
OH-F	varies	Construct New Upland Disposal Site	1	4	4	1		X	
OH-G	varies	Brandt Island Shoreline Stabilization	NA	3	NA	2		X	
OH-H	varies	Reduce Channel Dimensions	NA	5	1	NA		X	

Measure	Reason(s) Measure Eliminated
OH-12, OH-13 and A	Removes coarse-grained sediments(≥90% sand) from littoral system
OH-13, OH-15/ 15a/15b, OH-17/17b	Operationally not viable (mechanical dredge with scow in open ocean)
OH-14	Removes coarse-grained sediments(≥90% sand) from littoral system
OH-C	Modifying environmental windows would not benefit long-term management
OH-B, OH-D, OH-E	Does not provide enough capacity for a single dredging event
OH-F	No undeveloped uplands exist in the project vicinity
OH-G	An analysis was performed to determine if stabilizing the north shoreline of Brandt Island would decrease shoaling within the Harbor. Due to the limited change observed during this analysis, a shoreline stabilization measure was not evaluated further.
OH-H	Current commercial navigation traffic requires the full channel dimensions

Table 3-24. Screening of Measures for Maintenance of South Range B, Cutoff, North Range A to Station 110+00

South Range B, the Cutoff, and North Range A out to Station 110+00 contain coarse-grained sediments (greater than or equal to 90% sand) that may be beneficially used in either of the Nearshore Placement Areas or on the beaches of Fort Macon State Park, Atlantic Beach or Shackleford Banks. As shown in Table 3-24, there are several potentially viable options for the disposal of these sediments. Capacity, environmental acceptability and operational viability varied very little. With the exception of the ODMDS, these alternatives beneficially use the dredged material by keeping it in the "system". The determining trade-offs were beneficial use and costs. In attempting to balance ebb tide delta placement with beach disposal, the options selected were those that were the most operationally viable and provided the greatest benefit to the littoral system. Measures that are recommended in the base plan are use of a hopper or 30-inch pipeline dredge with placement in the Nearshore West, the Nearshore East or on the beaches of Fort Macon State Park and Atlantic Beach, or Shackleford Banks. As mentioned above, in the years when dredged material will be placed within the Nearshore Placement Areas (years 2 and 3), if appropriate dredge equipment is available, a concerted effort will be made to place the material in water depths less than 25 feet. Also, it should be noted that Range A between stations 110+00 and 117+00 contains sediments that are between 80% and 90% sand (Figure 1-4). Therefore, when placement is planned for the Nearshore Placement Areas, dredged material in Range A out to station 117+00 would be placed in the Nearshore Areas. In years when beach disposal is planned, only material out to station 110+00 of Range A (greater than or equal to 90% sand) would be disposed of on the beaches. As discussed below, any time material is dredged beyond station 117+00 of Range A, it would be disposed of in the ODMDS.

Outer Entrance Channel (OEC) - S. Range A from sta. 117+00 - sediments <90% sand									
Measure ID#	Dredging Method	Disposal/Placement Area	Disposal or Placement Capacity (1-5)	Environmental Acceptability (1-5)	Operational Viability (1-5)	Beneficial Use (1-5)	Cost (1-5)	Excluded	Total Score
OEC-1	18 or 30-inch pipeline	Brandt Island	2	5	1	1		X	
OEC-2	Bucket & Barge	ODMDS	5	5	1	1	4*	X	12
OEC-3	hopper	ODMDS	5	5	5	1	5	5	26
OEC-4	Bucket & Barge	Nearshore West	4	1	1	4		X	
OEC-5	Hopper	Nearshore West	4	1	2	4		X	
OEC-6	Bucket & Barge	Nearshore East	4	1	1	5		X	
OEC-7	Hopper	Nearshore East	4	1	2	5		X	
OEC-8	18-inch Pipeline	Fort Macon & Atlantic Beach	5	1	4	1		X	
OEC-9	30-inch Pipeline	Fort Macon & Atlantic Beach	5	1	4	1		X	
OEC-10	18-inch Pipeline	Shackleford Banks Beach	5	1	4	1		X	
OEC-11	30-inch Pipeline	Shackleford Banks Beach	5	1	4	1		X	
OEC-A	Bucket & Barge	Brandt Island	1	5	1	1		X	
OEC-B	30-inch pipeline	Nearshore West or East	4	1	3	5		X	
OEC-C	hopper	Bogue Banks or Shackleford Banks	5	1	4	1		X	
OEC-D	hopper	Marsh Island or Radio Island	1	5	2	1		X	
OEC-E	hopper	Modify Environmental Windows	NA	1	NA	NA		X	
OEC-F	varies	Construct Waterbird Islands	2	2	1	3	3		11
OEC-G	30-inch pipeline	Create Wetlands	1	3	3	4		X	
OEC-H	varies	Construct New Upland Disposal Site	1	4	4	1		X	
OEC-I	varies	Brandt Island Shoreline Stabilization	NA	3	NA	2		X	
OEC-J	varies	Reduce Channel Dimensions	NA	5	1	NA		X	
* Cost computed for comparison purposes only									

Measure	Reason(s) Measure Eliminated
OEC-1, OEC-A	Not cost effective, long pumping distance
OEC-2 , OEC-4, OEC-6	Operationally not viable (mechanical dredge with scow in open ocean)
OEC-4 thru OEC-11, OEC-B, OEC-C	Sediments not suitable for nearshore or beach disposal
OEC-A	Does not provide enough capacity for a single dredging event
OEC-D and OEC-G	Does not provide enough capacity for a single dredging event
OEC-F	- Fine-grained material not suitable habitat for waterbird nesting - Constructing an island with fine-grained material is not operationally viable
OEC-E	Modifying environmental windows would not benefit long-term management
OEC-H	No undeveloped uplands exist in the project vicinity
OEC-I	An analysis was performed to determine if stabilizing the north shoreline of Brandt Island would decrease shoaling within the Harbor. Due to the limited change observed during this analysis, a shoreline stabilization measure was not evaluated further.
OEC-J	Current commercial navigation traffic requires the full channel dimensions

Table 3-25. Screening of Measures for Maintenance of South Range A from Station 110+00 out

As shown in Table 3-25, viable options are very limited for the disposal of fine-grained material from the Outer Entrance Channel (South Range A from Station 117+00 out). The only measure that satisfactorily meets all screening criteria is the use of a hopper dredge with disposal in the ODMDS (OEC-3). Therefore, OEC-3 is the recommended measure for the Outer Entrance Channel (blue highlight).

3.4.2 Summary of Recommended Base Plan (DMMP)

Pursuant to ER 1105-2-100, it is the USACE policy to accomplish the disposal of dredged material associated with the construction or maintenance dredging of navigation projects in the least costly manner, consistent with sound engineering practice and in accordance with all federal environmental standards, including the environmental standards established by Section 404 of the Clean Water Act of 1972 or

Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA), as amended. This constitutes the base plan for the navigation purpose.

As shown in the trade-off analysis, numerous measures were considered and many subsequently eliminated in formulating the base plan for the DMMP. Table 3-26, below, summarizes the status of the disposal measures analyzed and identifies the beneficial use options that were considered. The measures not eliminated from further study make up the base plan, which is described in the following sections.

	Morehead City Harbor DMMP Alternatives & Measures		
#	**Description**	**Beneficial Use**	**Status**
1	**No Action (No DMMP)**	NA	eliminated
2	**Proposed DMMP (Measures Considered)**		
a	Brandt Island upland disposal site	No	in use
b	Place coarse-grained material (≥90% sand) on Bogue Banks	Yes	in use
c	Morehead City Ocean Dredged Material Disposal Site (ODMDS)	No	in use
d	Expand nearshore (ebb tide delta) placement area west of Beaufort Inlet	Yes	proposed
e	Create nearshore (ebb tide delta) placement area east of Beaufort Inlet	Yes	proposed
f	Place Inner Harbor material ≥80% sand in nearshore placement areas	Yes	possible future option
g	Expand and raise Brandt Island dike	No	possible future option
h	Raise existing Brandt Island dike (no expansion)	No	eliminated
i	Transfer Brandt Island material to ODMDS to regain capacity	No	eliminated
j	Recycle Material in Brandt Island through Hydrocyclone Density Separation	Yes	eliminated
k	Place coarse-grained material (≥90% sand) on Shackleford Banks	Yes	proposed
l	Continue to use existing nearshore placement area (no expansion)	Yes	eliminated
m	Modify environmental windows	No	eliminated
n	Construct colonial waterbird islands	Yes	eliminated
o	Dispose of dredged material on Radio Island	No	eliminated
p	Dispose of dredged material on Marsh Island	No	eliminated
q	Use dredged material to create wetlands	Yes	eliminated
r	Construct new upland disposal site	No	eliminated
s	Brandt Island shoreline stabilization	Yes	eliminated
t	Construct jetties at Beaufort Inlet	No	eliminated
u	Modify existing groin on west side of Beaufort Inlet	No	eliminated
v	Realign channels to improve navigation and reduce dredging	No	eliminated

Table 3-26. Status of Morehead City Harbor DMMP Measures

Maintenance dredging of authorized Morehead City Harbor Navigation project will continue as described in Section 2.5 (Future Without Project Condition), including adherence to the existing environmental windows, which include:

- Hopper dredging: January 1 to March 31 (Wilmington District protocol for sea turtles to minimize dredging impacts).
- Bucket and barge dredging: No window with the exception of an Inner Harbor dredging window that is being discussed with NCDMF.
- Pipeline dredging: No window
- Disposal: November 16 to April 30 for beach disposal on Bogue Banks; November 16 to March 31 for beach disposal on Shackleford Banks due to potential for nesting birds; January 1 to March 31 for nearshore placement; and September 1 to March 31 for disposal on Brandt Island, if needed to avoid impacts to nesting birds.

Management of the dredged material removed during each maintenance cycle will vary; specifically, changes to current maintenance practices include the expansion of the Nearshore West placement area, the addition of a new nearshore placement area east of Beaufort Inlet (Nearshore East) and the inclusion of Shackleford Banks for beach disposal. A summary of the base plan (DMMP) as compared to the No Action plan is shown below in Table 3-27 and the cycle of dredging and disposal proposed for the 20-year plan is shown in Table 3-28. A detailed cost estimate for the base plan is included in Attachment 1 of Appendix G. The recommended base plan is shown graphically on Figures 3-38 thru 3-40, below. Figure 3-40 shows Inner Harbor material going to Brandt Island every 3 years, however, after year 2028, when Brandt Island reaches capacity, this material likely will be disposed of in the ODMDS. Figure 3-41 shows all dredging and disposal areas addressed in this DMMP.

Plan	Navigation Section	Range	Dredging Freq. (year)	Brandt Island	Fort Macon/Atlantic Beach	Shackleford Banks Beach	Nearshore West	Nearshore East	ODMDS
Proposed DMMP	Inner Harbor	Northwest Leg/West Leg 1/East Leg (<80% sand)	3	362,000	none	none	none	none	none
		West Leg 2 /North Range C (≥80% sand)	3	152,000	none	none	*	*	none
	Outer Harbor	S. Range C-N. Range B (≥90% sand)	3	none	none	none	270,000	76,000	**
		S. Range B, Cutoff, N. Range A (≥90% sand)***	1	none	684,000	516,000	1,139,000	321,000	**
	Outer Entrance Channel	S. Range A, Sta.110 out (<80% sand)	3	none	none	none	none	none	344,000
No Action	Inner Harbor	Northwest & West Leg	3	362,000	none	none	none	NA	
		East Leg-N. Range C	3	152,000	none	none	none	NA	none
	Outer Harbor	S. Range C-N. Range B	3	none	none	none	346,000	NA	~40% of total
		S. Range B, Cutoff, N. Range	1	none	1,200,000	none	1,500,000	NA	~40% of total
	Outer Entrance Channel	S. Range A, Sta.110 out	3	none	none	none	none	NA	344,000

* This material may go in the nearshore if costs are feasible, i. e. combined with an AIWW contract

** Contracts may not include an option to place material in the ODMDS during adverse weather

*** For this Range, Year 1 of the 3-yr. dredging cycle to be done by 30" pipeline;2nd & 3rd years to be done by hopper

Table 3-27. Comparison of Proposed DMMP (base plan) with the No Action Plan. Dredging Quantities Rounded

DMMP Cycle	Harbor Section	Navigation Range Dredged	Dredge Plant	Proposed Disposal/Placement Location	Quantity Likely to be Dredged (cy)	Estimated Unit Cost	Estimated Cost (per dredging event) *
Years 1, 4, 7, 10…	Outer	S. Range B, Cutoff, N. Range A to Sta. 110+00	30-inch pipeline	Fort Macon State Park/Atlantic Beach & Shackleford Banks	1,200,000	$7.82	~$16,791,300
Years 2, 5,8,11…	Outer	S. Range C-N. Range B	hopper	Nearshore West & East	346,000	$4.25	~$6,457,900
	Outer	S. Range B, Cutoff, N. Range A to Sta. 117+00	hopper	Nearshore West & East	650,000	$4.10	
Years 3,6,9,12…	Inner	Northwest Leg, West Leg 1 & East Leg	18-inch pipeline	Brandt Island or ODMDS	362,000	$4.35	~$10,175,600**
	Inner	West Leg 2 & N. Range C	18-inch pipeline	Brandt Island or ODMDS	152,000	$4.30	
	Outer	S. Range B, Cutoff, N. Range A to Sta. 117+00	hopper	Nearshore West & East	810,000	$4.10	
	Outer Entrance Channel	S. Range A, Sta. 110+00 out	hopper	ODMDS	344,000	$3.50	

* Costs include monitoring, mob/demob, planning, engineering and design, supervisory and administrative costs and 20% contingency

** When Inner Harbor material is disposed of in the ODMDS (once Brandt Island reaches capacity), costs increase to $12,083,500 per dredging event.

Table 3-28. Proposed DMMP Cycle of Dredging and Disposal (numbers rounded)

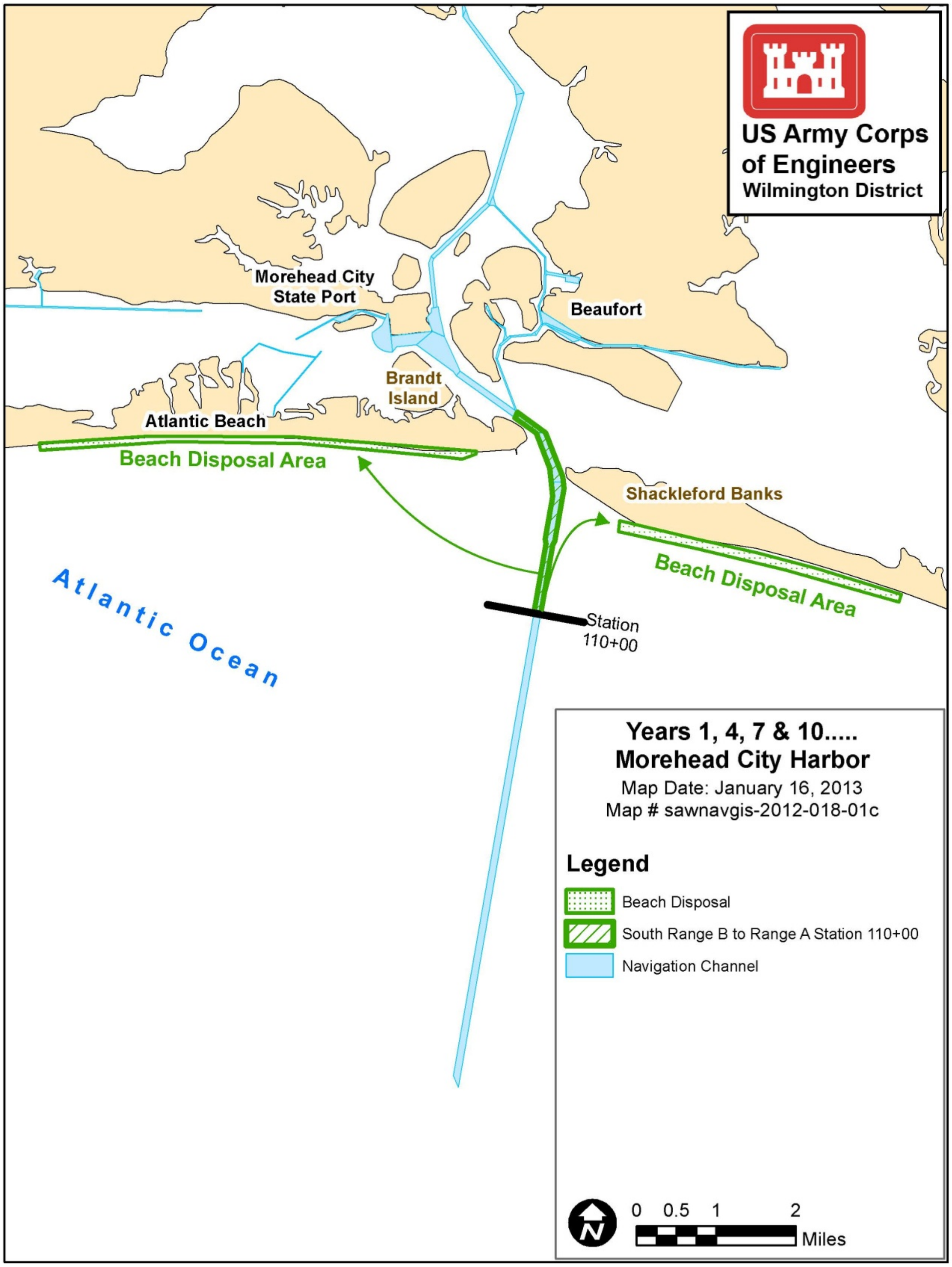


Figure 3-38. Proposed Base Plan – Years 1,4,7,10…….

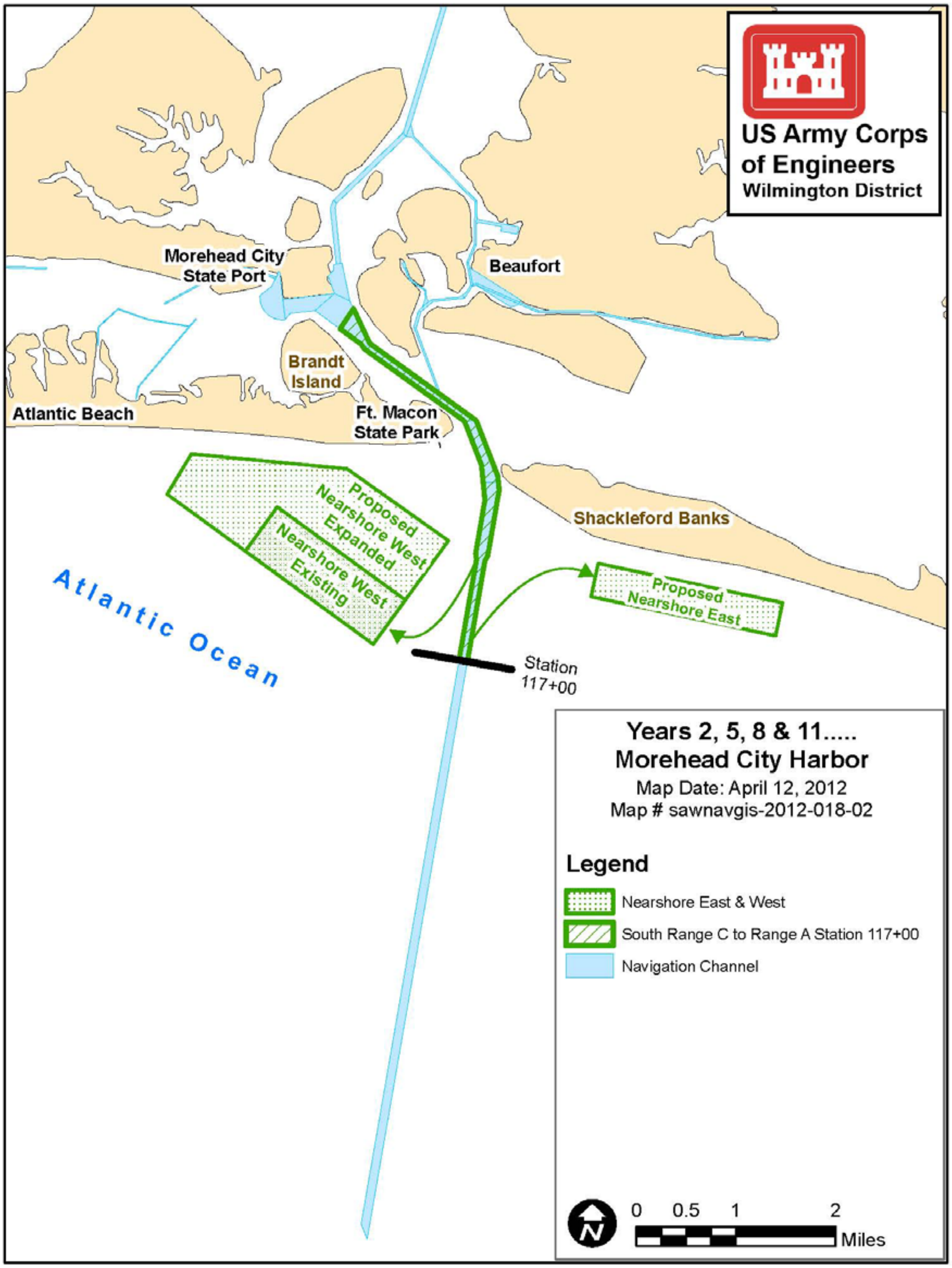


Figure 3-39. Proposed Base Plan – Years 2, 5, 8, 11…..

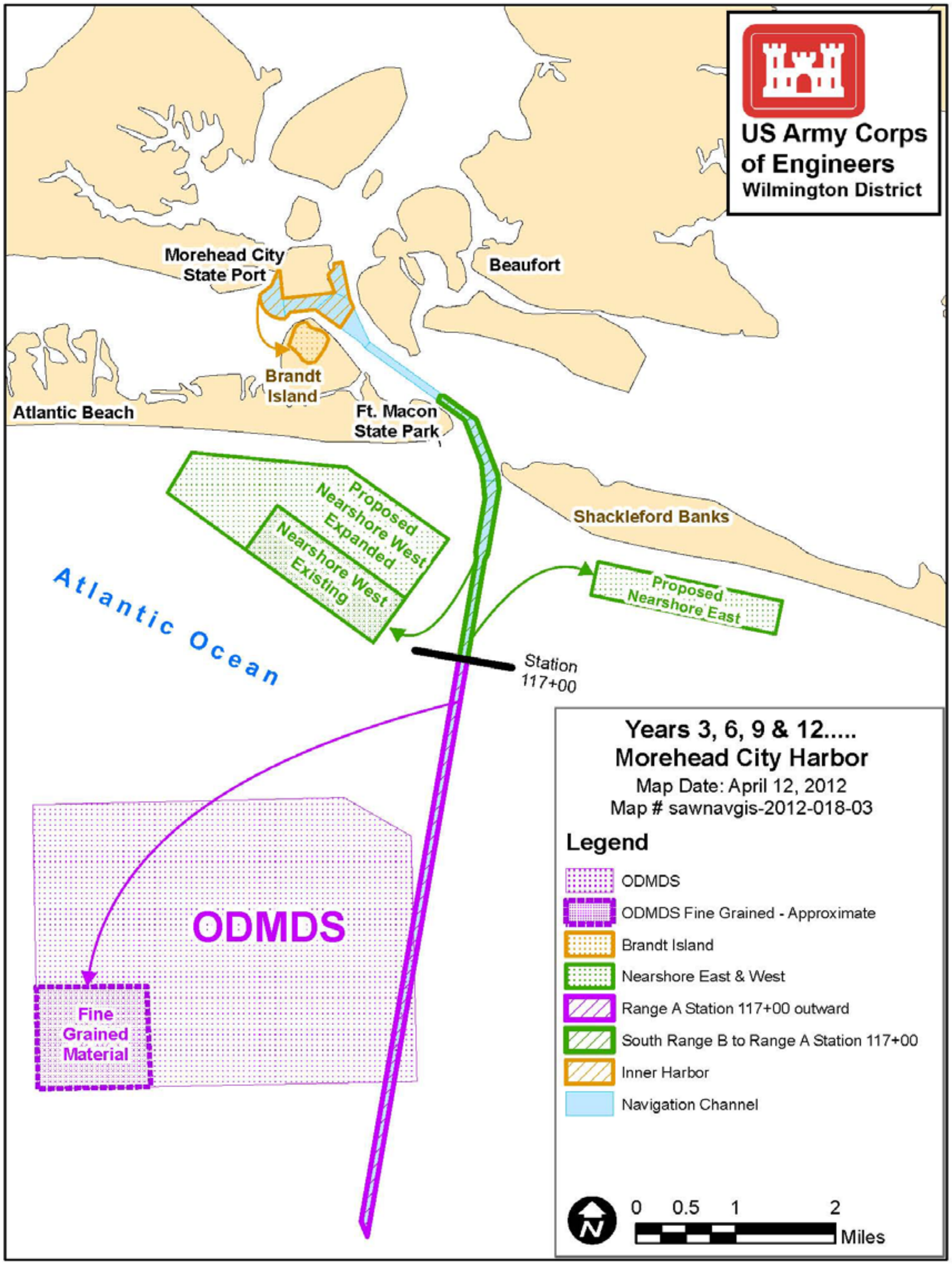


Figure 3-40. Proposed Base Plan – Years 3,6,9,12………

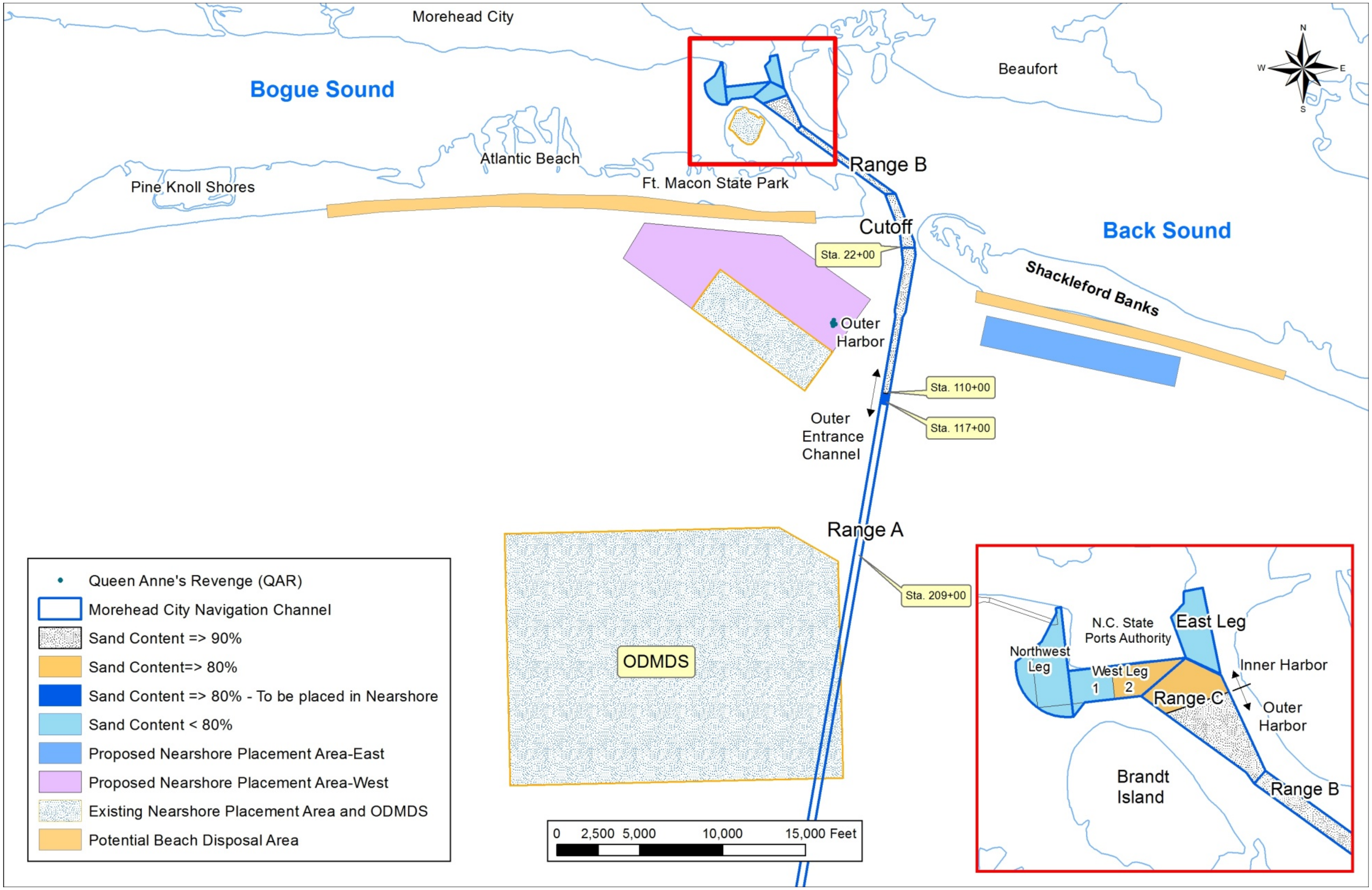


Figure 3-41. Summary of all Dredging and Disposal Locations

As shown in the tables and figures above, the proposed base plan is based on a 3-year maintenance cycle, which is the most efficient way to maintain the Harbor. Specifically, and as further described below, the 3-year plan balances the following important elements of long-term project maintenance:

1) Staggered needs for channel maintenance. Due to differences in shoaling rates, different reaches of the channel require maintenance at different intervals. Some must be maintained annually and some can be effectively maintained on a less frequent basis. Specifically, most of the Inner Harbor reaches can be maintained approximately once every 2 or 3 years and still support traffic. The Outer Entrance Channel can also be maintained roughly once every 2 to 3 years. The Cutoff area and some portion of Range A requires annual maintenance dredging.

2) Optimum dredge plant for channel maintenance. Different types of dredge plant are most effective for dredging different areas of the channel. The Outer Entrance Channel can only be effectively maintained by a hopper dredge, as it is 47 feet deep, experiences string-bean shoaling, is far from shore, and close to the ODMDS disposal area. The rest of Range A can be effectively maintained by either a hopper or a large cutterhead pipeline dredge, and flexibility is required; depths are still 47 feet, open ocean conditions exist, and string bean shoals do occur, but if bank height from encroaching shoals is high enough, a pipeline may be the best tool. The Cutoff needs a large cutterhead pipeline (at least 24", preferably 30") to meet the full channel prism, as the encroaching tip of Shackleford Island creates large, steep shoals. A hopper dredge can effectively maintain the central channel of the Cutoff in subsequent years, but if a pipeline dredge is not mobilized at least once every three years, the slopes become too steep for a hopper dredge to effectively operate. Range A and the Cutoff can also be maintained by a bucket and barge. Ranges B and C can be maintained effectively by any type of dredge, allowing them to be added to any contract as needed; disposal locations, more than dredging conditions, dictate dredge plant requirements. The Inner Harbor reaches are tight quarters that cannot be effectively navigated by hopper dredges; overflow restrictions also limit hopper effectiveness (and reduce mechanical dredge efficiency as well). A small (18") pipeline dredge is usually the best tool in these areas, but occasionally a mechanical dredge may be best.

3) Environmental considerations. Important environmental considerations include endangered and threatened species, essential fish habitat, and benthic organisms. Other considerations include the need to **not** place material on the same stretch of beach in subsequent years to allow for benthic species recovery, and the need to provide some regular inputs of sand to both sides of the ebb tide delta and both adjacent shorelines.

4) Cost. In order to maintain all areas of the project in a way that allows for the Port to operate effectively and allow USACE the ability to use its funds efficiently, some form of dredging contract will be required at Morehead City Harbor annually, incorporating different areas of the project in a manner that best utilizes the dredge plant necessary to do the work. Shoaling always makes some amount of maintenance necessary, and the

District strives each year to incorporate into its contract the most pressing navigation needs. Therefore adequate contract planning is critical to successfully meet the project's anticipated shoaling for each year. Beach disposal is very expensive, and cannot likely be afforded more than once every three years at best; however, the Cutoff can only be properly maintained with periodic use of a cutterhead pipeline dredge, so the plan must account for that type of contract often enough to keep the channel open. It is the need for a cutterhead pipeline dredge which drives the 3-year cycle of this plan -- if a cutterhead pipeline dredge is mobilized less than once every three years, the slopes of the cutoff channel steepen and the channel closes in to a degree that it cannot be effectively maintained by a hopper in the off-years. Additionally, the potential of project-induced erosion increases, particularly at the ends of the flanking barrier islands. If a pipeline dredge is mobilized more often than once every three years, costs become too great, the effects on beach organisms increase, and less material is provided to the ebb tide delta. Cost estimates have also shown that pipeline dredging with nearshore placement is not any cheaper than beach disposal.

In summary, Wilmington District USACE recommends a 3-year cycle that most effectively matches anticipated dredge plant with the areas that need to be maintained. This plan is the best balance of dredging needs, available dredge plant, environmental concerns, and costs.

As shown in Table 3–27, the recommended base plan provides more than one potential disposal option for most of the ranges of the Morehead City Harbor navigation channels, depending on the type of dredge equipment mobilized. Although dredged material from most of the Morehead City Harbor ranges may be disposed of in more than one location, Table 3–27 displays the plan that best meets the Federal Standard of least cost, engineeringly sound and environmentally acceptable disposal. The 3-year cycle is graphically depicted in Figures 3-38 through 3-40. Quantities shown in the tables above are based on adjusted shoaling rates (Section 2.4) and represent the material likely to be dredged in order to maintain the channel to authorized dimensions. However, due to funding limitations and navigation priorities, actual dredging quantities from the Morehead City Harbor channels will vary and are expected to be less than the quantities shown above.

As shown in Table 3-28, plans are to dredge the Outer Harbor reaches annually. During the first year, the Outer Harbor ranges (from South Range C out to Station 110+00 of Range A) would be dredged by a 30-inch pipeline to the fully authorized project depth of 45'+ 2 feet of allowable overdepth with disposal on the beaches of Fort Macon State Park, Atlantic Beach and Shackleford Banks. Comparison of the volumetric losses calculated earlier in this section shows that the recent loss trends for both islands are relatively similar and the recommended plan is for the coarse-grained (≥90% sand) dredged material to be returned to the beaches in ratios comparable to calculated sediment losses, resulting in a 57/43 split of material disposed of on Bogue Banks and Shackleford Banks, respectively. Following the initial disposal, these ratios may be reevaluated based on the performance of the material disposed of and beach disposal limits may be adjusted to maximize the benefits while minimizing costs and environmental impacts. Assuming the final base plan includes disposal of dredged material on Shackleford Banks, the National Park has the option to decline the disposal of dredged material on Shackleford Banks during any maintenance dredging event. Under the base plan, quantities expected to be disposed of on the beaches are greater than quantities disposed of on the beach in the past from the Brandt Island pumpout.

During the second and third years of the 3-year maintenance cycle, a hopper dredge would be mobilized to dredge the Outer Harbor ranges out to Station 117+00 to a depth of 45'+ 2 with placement of material in the Nearshore Placement Areas. Dredged material quantities to be placed in the Nearshore Areas would be based on the ratio of the historic losses for the two lobes (west and east) of the ebb tide delta. As discussed in Section 3.2.4 Ebb Tide Delta, 78% of sediment losses occurred on the west ebb tide delta and 22% of losses occurred on the east ebb tide delta. Therefore, material placed within the ebb tide delta will be split between the western and eastern lobes based on this 78/22 ratio.

The disposal of all Outer Harbor material will be based on data provided by the Morehead City Harbor Monitoring Plan (Appendix F) and beach disposal limits may be modified to best address any shoreline conditions. Additionally, quantities placed will always be subject to navigation priorities and the availability of dredging funds which may not be sufficient to place quantities equivalent to the historic loss rates.

With the exception of sediments in Range A from Station 110+00 to Station 117+00 which contain sediments ≥80% sand, sediments in the Outer Entrance Channel (Range A from Station 110+00 seaward) are predominantly fine-grained and cannot be disposed of on the beaches or in the Nearshore Placement Areas. The least cost, engineeringly sound, environmentally acceptable alternative for the Outer Entrance Channel sediments is disposal in the ODMDS. The DMMP proposes to dredge this portion of the Harbor to a depth of 47'+2 by hopper dredge in year three of the three year cycle.

3.4.3 Real Estate

The DMMP addresses dredging needs, disposal capabilities, and capacities of disposal areas with the purpose of ensuring sufficient disposal capacity for at least the next 20 years, beginning in 2015 and extending through 2034. The Proposed Base Plan to accomplish the disposal of dredged material associated with the maintenance dredging of Morehead City Harbor is discussed at Section 3.4 (Proposed Base Plan (DMMP)). Maintenance dredging is proposed for three areas, the Inner Harbor, Outer Harbor and Outer Entrance Channel. Areas considered for disposal of dredged material are:

- Brandt Island
- Beaches at Fort Macon State Park, Atlantic Beach and Shackleford Banks
- Nearshore West
- Nearshore East
- Ocean Dredged Material Disposal Site (ODMDS)

Brandt Island. A large portion of the Island (Figure 1-4) is owned by the State of North Carolina and since the 1950's has been dedicated for use as a disposal area. It is proposed that dredged material from the Inner Harbor be disposed of in Brandt Island. For past disposal events the State of North Carolina has either granted a temporary disposal easement or given a letter permit for use of the Brandt Island site. The same would be required for any subsequent use of the site.

Beaches at Fort Macon State Park. Dredged materials from the Outer Harbor will likely be disposed of on the beach of Fort Macon State Park (Figure 1-4), which is owned by the State of North Carolina. No formal agreement exists between the USACE and the State pertaining to disposal of material at Fort Macon. However, prior to each disposal event, the USACE coordinates closely with the State Park regarding the details of the disposal activity and obtains approval for disposal of dredged material on the Fort Macon shoreline. Either an easement or a letter permit from the State will be required to make Fort Macon State Park available for project purposes.

Beaches of Atlantic Beach. Dredged materials from the Outer Harbor will also be disposed of on Atlantic Beach (Figure 1-4), which is privately owned landward of mean high water (mhw). In 2005, sand was pumped from Brandt Island onto the beaches of Fort Macon and Atlantic Beach to create more disposal capacity within the Brandt Island site. At that time, 209 parcels on Atlantic Beach were impacted by the disposal of fill. There were 150 perpetual easements in place and 59 temporary easements were acquired, which have since expired. The easement language used in the acquired easements was very similar to the standard “Perpetual Beach Storm Damage Reduction Easement” shown below.

An assumption is that the last sand disposal created new lands which vested in State ownership. The expectation with future disposal events is that fill will be disposed of on or below the land created at the last fill and that no further real estate interests will be required; however, this will be confirmed when surveys are completed prior to each beach disposal event. Should there be areas where erosion has occurred landward of the old mean high water line, easements will be required from impacted landowners. It is suggested that the standard Perpetual Beach Storm Damage Reduction Easement be used if additional easements are required.

PERPETUAL BEACH STORM DAMAGE REDUCTION EASEMENT

> A perpetual and assignable easement and right-of-way in, on, over and across (the land described in Schedule A) (Tract No. __) for use by the (Project Sponsor), its representatives, agents, contractors, and assigns, to construct; preserve; patrol; operate; maintain; repair; rehabilitate; and replace; a public beach [a dune system] and other erosion control and storm damage reduction measures together with appurtenances thereto, including the right to deposit sand; to accomplish any alterations of contours on said land; to construct berms [and dunes]; to nourish and renourish periodically; to move, store and remove equipment and supplies; to erect and remove temporary structures; and to perform any other work necessary and incident to the construction, periodic renourishment and maintenance of the (Project Name), together with the right of public use and access; [to plant vegetation on said dunes and berms; to erect, maintain and remove silt screens and sand fences; to facilitate preservation of dunes and vegetation through the limitation of access to dune areas;] to trim, cut, fell, and remove from said land all trees, underbrush, debris, obstructions, and any other vegetation, structures and obstacles within the limits of the easement (except___*__); [reserving, however, to the grantor(s), (his) (her) (its) (their) (heirs), successors and assigns, the right to construct dune overwalk structures in accordance with any applicable Federal, State or local laws or regulations, provided that such structures shall not violate the integrity of the dune in shape, dimension or function, and that prior approval of the plans and specifications for such structures is obtained from the (designated representative of the Project Sponsor) and provided further that such structures are subordinate to the construction, operation, maintenance, repair, rehabilitation and replacement of the project; and further] reserving to the grantor(s), (his) (her) (its) (their) (heirs), successors and assigns all such rights and privileges as may be used and enjoyed without interfering with or abridging the rights and easements hereby acquired; subject however to existing easements for public roads and highways, public utilities, railroads and pipelines.

The worst case scenario under the recommended base plan is acquisition of 59 easements. Real Estate cost would include the review and certification of Real Estate prior to advertisement for construction. The estimated cost is $6,500 (Appendix N). Should future beach disposal occur on Bogue Banks west of the area included in the base plan, additional easements would be required, incurring additional real estate costs that cannot be accurately estimated at this time. Disposal of sand along the shoreline is considered beneficial use of dredged material and is not considered a nourishment project. The sponsor will not receive credit for cost incurred in the acquisition of easements.

Beaches of Shackleford Banks. The beaches of Shackleford Banks (Figure 3-38) may also receive dredged material from the Outer Harbor. Shackleford Banks is part of the Cape Lookout National Seashore, which is managed by the National Park Service. A Special Use Permit (SUP) will be required from the NPS prior to each disposal event and all conditions of the SUP will be met. No other real estate is required.

The dredge contractor will not be allowed to impact the existing frontal dune along the ocean strand from the spit to the disposal area on Shackleford Banks. All beach equipment (dozers, pipeline sections, etc.) will be walked during low tide along the beach strand to the disposal site. This also means that no dredge pipeline from the dredge to the disposal area will be aligned along the ocean beach strand from the spit to the disposal area on Shackleford Banks. The end of the dredge pipeline will be submerged offshore from the dredge working in the Harbor channels to the disposal site on Shackleford Banks. Once the end of the dredge pipeline emerges onshore within the sediment berm disposal site, the contractor will set up the dump shack, fencing, light stands and stockpile additional shore pipe within the constructed upland berm area (seaward of the existing frontal dune).

Nearshore West. The Nearshore West Placement Area (Figure 3-22) is within State waters and is located off Bogue Banks. Dredged material from the Outer Harbor will be disposed of in the Nearshore West site. The existing site is 559 acres but the recommended base plan proposes to expand the existing site by an additional 1,209 acres. This is discussed in further detail in Sections 4 and 5 of this report. The proposed expansion is being coordinated with all appropriate resource agencies and approval from the State will be obtained prior to use of the expanded area.

Nearshore East. The Nearshore East Placement Area (Figure 3-23) is a newly proposed site that will consist of approximately 1,094 acres and will be located within State waters off Shackleford Banks. Dredged material from the Inner Harbor will be placed in the Nearshore East. This is discussed in further detail in Sections 4 and 5 of this report. The proposed Nearshore East is being coordinated with all appropriate resource agencies and approval from the State will be obtained prior to use of the expanded area.

ODMDS. The ODMDS (Figure 3-40) is an 8 square mile area located on the Outer Continental Shelf (OCS). The site was designated by USEPA as an ocean dredged material disposal site. The transportation and disposal of dredged material in ocean waters, including the territorial sea, is regulated under the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA) (Public Law 92-532, 86 Stat. 1052, 33 U.S.C. §§1041 et seq.) as amended by Title V of the Water Resources Development Act of 1992 (WRDA 92; Public Law 102-580). Section 102(a) of MPRSA authorizes the USEPA to establish and apply regulations and criteria for ocean dumping activities. Consequently, the USEPA issued in October, 1973, and revised in January, 1977, Ocean Dumping Regulations and Criteria (40 CFR 220-238). These regulations establish control of ocean dredged material disposal primarily by two activities, designation of sites for ocean dumping and the issuance of permits for dumping.

The transportation of dredged material for the purpose of disposal into ocean waters (i.e. the actual use of the designated site) is permitted by USACE (or authorized in the case of federal projects) under MPRSA Section 103(e) applying environmental criteria established in USEPA's Ocean Dumping Regulations and Criteria. The MPRSA Section 104(a)(3) provides that ocean disposal of dredged material can occur only at a designated site and Section 103(b) requires the USACE to utilize dredged material disposal sites designated by USEPA to the maximum extent feasible. Prior to issuing a dredged material permit or authorizing a federal project involving the ocean disposal of dredged material, the USACE must notify USEPA, who may disapprove the proposed disposal. Dredged material from the Inner Harbor, Outer Harbor and Outer Entrance Channel may be disposed of in the ODMDS.

No staging areas have been identified at the time of this report. When specific requirements are determined, the sponsor will be responsible for providing staging areas for the project prior to advertisement for construction. However, should a contractor determine that another site may be more convenient or suitable, he will have the option to obtain an alternate site for staging.

4 AFFECTED ENVIRONMENT

Background. Section 3.4.2 describes the Proposed Base Plan and Figures 3-38 through 3-40 graphically show the proposed base plan. The project area is located in the lower Atlantic Coastal Plain Physiographic Province, along the central coast of North Carolina. More specifically, the Morehead City Harbor channel passes through Beaufort Inlet between the barrier islands of Shackleford Banks and Bogue Banks and continues inland to the mainland at Morehead City and Beaufort North Carolina. The channel is flanked by shoals of the ebb-tidal delta seaward of the inlet and by those of the flood-tidal delta landward along Back Sound on the east. Farther inland, the channel is flanked by Bogue Sound on the west. The Newport River empties into Morehead City Harbor at the head of the channel, i.e., the northernmost end of the Harbor. The DMMP study area encompasses depositional environments that include nearshore littoral settings, an active coastal inlet, barrier islands, and a shallow, back barrier lagoon complex of sounds and channels.

Bogue Banks is the longest island south of Cape Lookout. It is a 25 mile barrier island, stretching from Bogue inlet to Beaufort inlet in Carteret County. The barrier island, separated from the mainland by Bogue Sound, runs east to west, with the ocean beaches facing due south. Bogue Banks is developed and can be accessed by one of two bridges across Bogue Sound, either from Morehead City to Atlantic Beach, which is the more heavily traveled bridge, or from Cape Carteret to Emerald Isle. The State park/communities of Bogue Banks are (from east to west) are Fort Macon State Park, Atlantic Beach, Pine Knoll Shores, Salter Path/Indian Beach, and Emerald Isle. Bogue Banks includes some hotels/motels but is dominated by private homes, many of which are rented out during the summer. Bogue Banks also contains areas of maritime forest.

Stores and other commercial properties are limited to the five main communities. The proposed dredged material disposal area on Bogue Banks is about 10 miles in length and extends from Fort Macon State Park to Pine Knoll Shores.

Shackleford Banks is a barrier island that is part of the National Park Service (NPS), Cape Lookout National Seashore (CALO), which consists mostly of wide bare beaches with dunes covered by scattered grasses; flat grasslands bordered by dense maritime vegetation and large expanses of salt marsh alongside Back Sound. Congress established Cape Lookout National Seashore (CALO) in 1966 to conserve and preserve for public use and enjoyment the outstanding natural, cultural, and recreational values of a dynamic coastal barrier island environment for future generations. The CALO is located three miles off the mainland coast in the central coastal area of North Carolina and occupies more than 29,000 acres of land and water from Ocracoke Inlet on the northeast to Beaufort Inlet to the southwest. The CALO National Seashore consists of four main barrier islands (North Core Banks, Middle Core Banks, South Core Banks, and Shackleford Banks). There are no road connections to the mainland or between the islands. As shown on Figure 3-10, the project area on Shackleford Banks is from the spit off Beaufort Inlet to the end of the 3.65 mile dredged material disposal area. Shackleford Banks is located adjacent to the existing Cutoff reach of the federal navigation channel. The beachfront within the project area serves as a high-usage recreation beach for visitors transported by private boats or to the existing pier/dock via ferry vessels from Harkers Island, Beaufort, and Morehead City.

4.1 Physical Resources

4.1.1 Sediment Background

The following information (in italics) was taken from Appendix B, Geotechnical Appendix, Feasibility Report and Environmental Assessment, Morehead City Harbor Improvement, Morehead City, North Carolina, dated June 1990 and revised December 1990 (USACE 1990):

The prominent geographical feature of the region is Cape Lookout, which is composed of a lobate sand body ranging up to 90 feet in thickness and covering an area of approximate 100 square miles. The western edge of the Cape Lookout shoal lies immediately east of the entrance channel. Shackleford Banks is a Holocene age barrier island that is underlain by extensive deposits of inlet filled sediments along its entire length. Historically, an inlet or inlets have opened and closed along the full length of the island, while displaying an overall westward lateral movement to the present-day Beaufort Inlet location. Back Sound, landward of Shackleford Banks, is underlain by stacked sequences of flood-tidal delta deposits, which stratigraphically compliment the inlet-fill sequences under the island. Holocene age shoreface deposits underlie Bogue Banks, to the west of the channel. The barrier sands of the island are prograding seaward over these deposits at present. Bogue Sound, landward of this island, is underlain by back-barrier lagoonal sequence of sediments having a greater abundance of clays than Back Sound to the east. The entire sequence of barrier/back-barrier *sediments in the area represents several transgressive/regressive ocean events that occurred during Pleistocene and Holocene time.*

Sediments within the Morehead City Harbor channels range from Pliocene to Holocene in age. The Pliocene sediments are from the Yorktown formation and are only found in limited areas (i.e., the turning basin and possibly along portions of Ranges B and C). The top of the Yorktown sediments range between –45 and –50 mean sea level (MSL) in the Inner Harbor area and to about –65 feet MSL at Beaufort Inlet. These sediments consist of bluish to greenish-gray, clayey sands and interbedded clay and sandy clay, all of which have abundant fossil debris. Generally the Yorktown is more indurated than the overlying sediments. The Pleistocene sediments are from the Core Creek Sand. Within the inlet, these sediments are at approximately –50 to –54 feet msl. Beneath Bogue Banks and Shackleford Banks, the Pleistocene varies from –45 feet msl to –55 feet msl, respectively. In the landward direction, the top of the Core Creek Sand rises along the dip such that it is only 15 to 20 feet below msl. Pleistocene deposits from Beaufort sand form a ridge along the mainland at the rear of Back and Bogue Sounds, as part of the Core Creek Plain (Pamlico Plain of Stephenson, 1912). This plain is a shallow, seaward dipping surface, which lies east and south of the Suffolk Scarp. In general, the Pleistocene sediments in the project area are representative of back-barrier and nearshore or shoreface deposits consisting of interbedded clays, silts, and fine sands, and poorly graded fine to medium sands and shelly sands, respectively. Holocene sediments are undifferentiated. They are the uppermost sediments at the site. Within the inner harbor, they consist of some reworked clays and silts but are predominately very fine to fine sands that are derived from Bogue and Back Sounds and the Newport River. Coarser sediments are concentrated in the channels. Holocene deposits are derived from the ongoing reworking of older sediments along the nearshore seabed and the Cape Lookout sand body. Deposits in each of the stratigraphic units are interbedded vertically and interfinger horizontally (facies changes) as the environments of deposition changed across the project area.

4.1.2 Sediment Characteristics

This section describes the sediment analyses that have been completed for the beaches of Shackleford Banks and Bogue Banks as well as the navigation channel sediments. Section 4.1.3 describes the sampling efforts and sediments in the nearshore placement areas.

Shackleford Banks. In May 2011, the Wilmington District completed the characterization of the native beach sediment on Shackleford Banks (USACE 2011). About 14 sediment samples were taken along each of 46 transects (from the beach dune to -30 foot elevation) about every 1,000 feet of shoreline on Shackleford Banks from Barden (Transect 00) to Beaufort (Transect 460) Inlets. Figures 4-1 and 4-2 show transect and sample locations along each transect on Shackleford Banks.

In the upland beach area, six surface samples were collected. For each transect, one grab sample was collected from each of the following six locations:

1) dune (DN);
2) seaward toe of the dune, dune base (DB);
3) crest of the berm (BC) approximately at elevation +7 NGVD;
4) mean high water (MHW), approximately at elevation +2.1 NGVD;
5) mean sea level (MSL) , approximately +0.0 ft NGVD; and
6) mean low water (MLW), approximately elevation –1.9 NGVD.

In the ocean, eight surface samples were collected from each of the transect lines. For each transect, one grab sample was taken at 6-foot increments of elevation beginning at elevation -6 NGVD through elevation –30 NGVD. In addition, a sample was taken at the trough, the bar crest, and -10 MLW. Transects which intersect Barden's Inlet were sampled to the deepest point of the Inlet. Samples were not taken along the transect beyond the deepest part of Barden's Inlet. The samples were collected from the top one to four inches of ground surface.

The grain size distributions of the 647 Shackleford Banks sediment samples were analyzed using the American Society for Testing and Materials (ASTM) test procedure D 422 entitled "Standard Test Method for Particle-Size Analysis of Soils" and D 2487 "Classification of Soils for Engineering Purposes". The following 16 sieve sizes were used: 3/4", 3/8", #4, #7, #10, #14, #18, #25, #35, #45, #60, #80, #120, #170, #200, and #230 for the test procedure D 422. The hydrometer portion for the test procedure D 422 was not required for the material passing the Number 230 sieve. The percent shell content of each sample was determined by estimating visually the amount of shell on each sieve, during the sieve procedure, to determine the overall sample shell content. The color of all sediment samples (dry) was determined using the Munsell Color System.

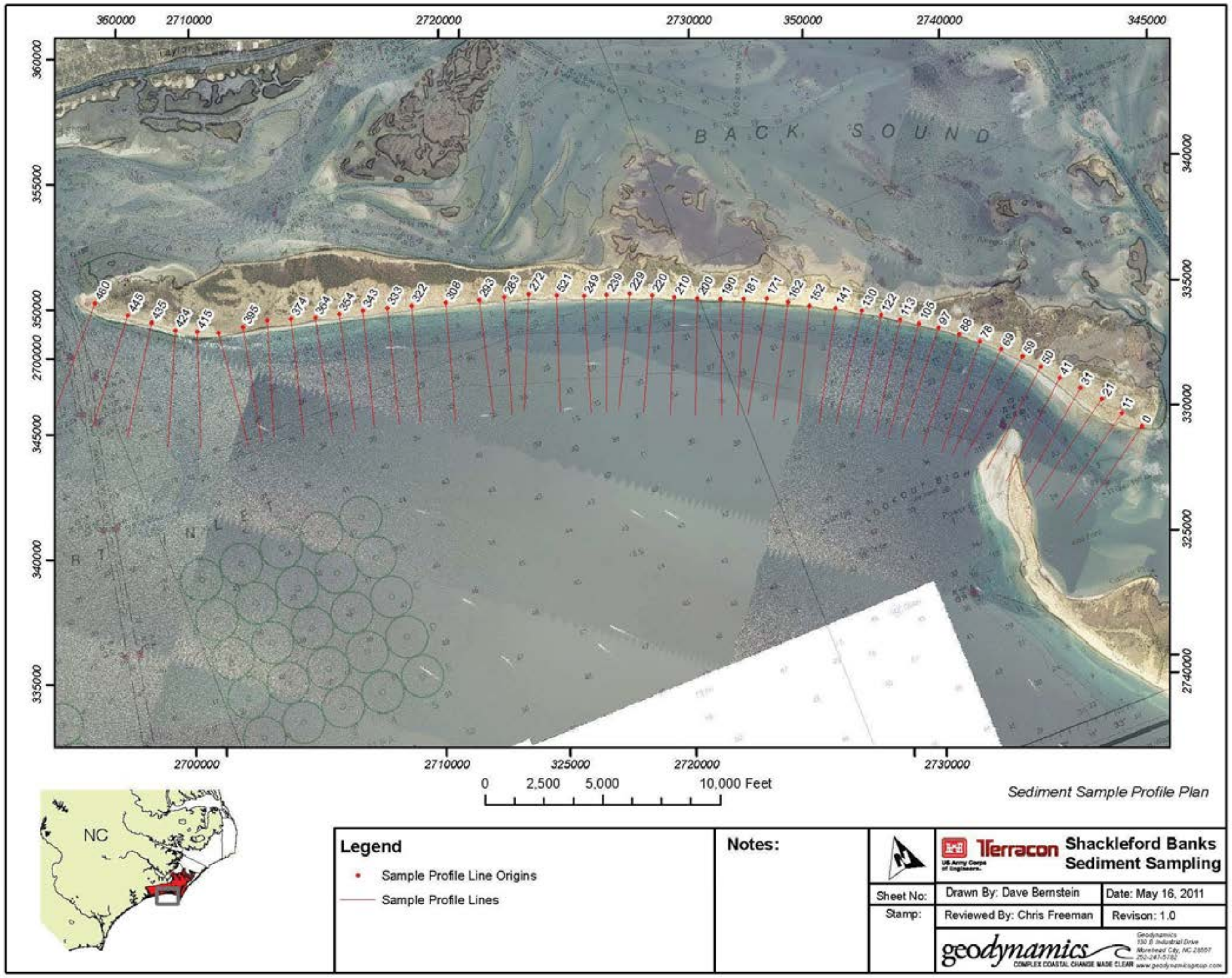


Figure 4-1. Shackleford Banks Sediment Sampling Transects.

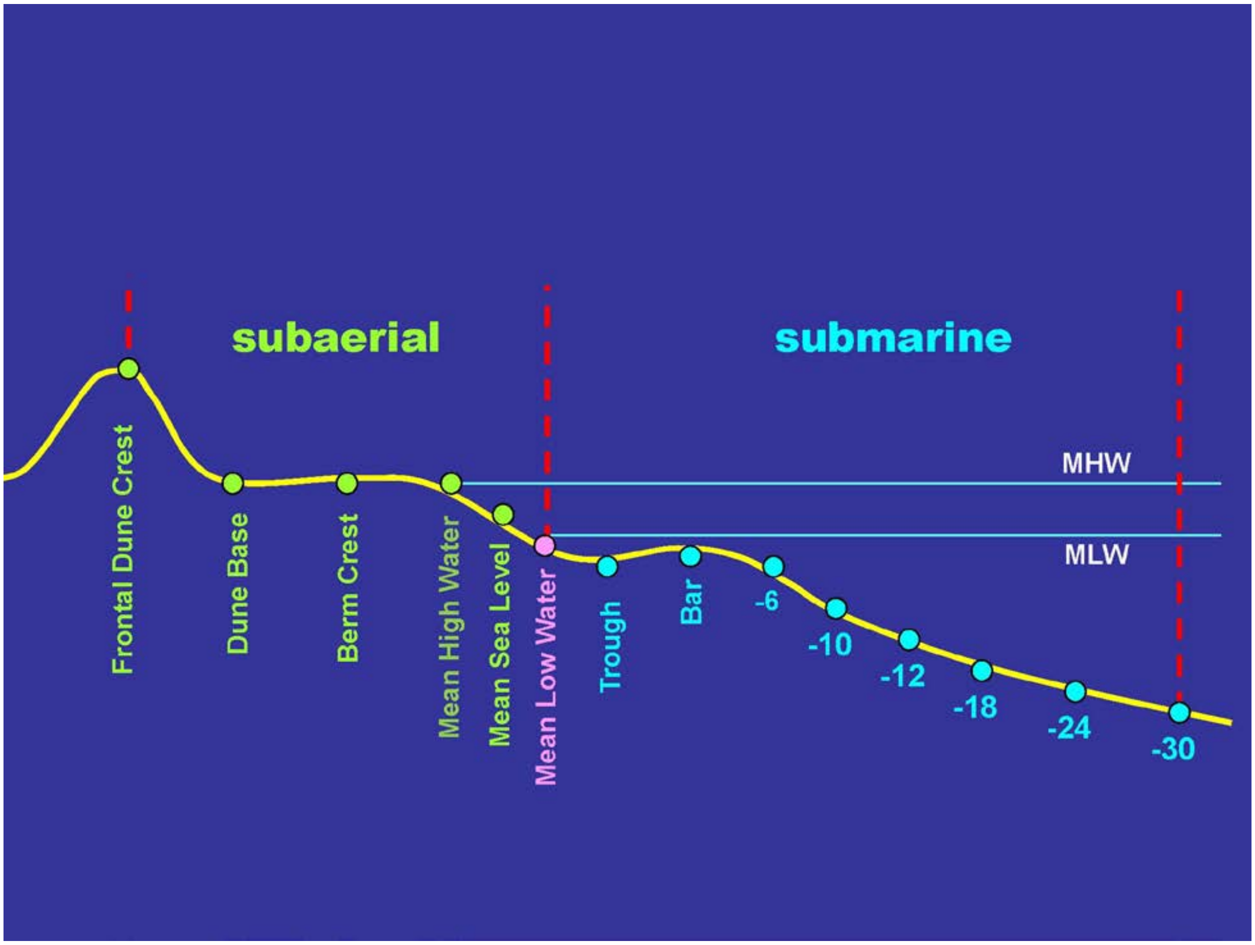


Figure 4-2. Grab Sample Locations Along Beach Transects (profiles) at Shackleford Banks Beach. On Bogue Banks, submarine samples were taken at 2-foot increments beginning at elevation -4 NGVD through elevation -24 NGVD.

Morehead City Harbor Navigation Channel. Between 2005 and 2008 numerous vibracore borings were performed in the Morehead City Harbor Channel (Figure 4-3) to determine the characteristics of dredged materials (USACE 2008b). The Morehead City Harbor ranges where sediments were collected were Ranges A, B, C, and the Cutoff.

Borings designated MIH-05-V-# and MOB-05-V# were vibracore borings performed in 2005. Borings designated MHC-06- # are vibracore borings performed in 2006. These borings are located in Range C. Borings designated MHCOB-07-V-# are vibracore borings performed in 2007. Borings designated MHC-08-V-# are vibracore borings performed in 2008. These borings are located throughout the Morehead City Harbor Channel from Range C to Range A. They represent the most comprehensive set of borings performed to date for the identification of material to be dredged. All borings were drilled to a depth below the dredging depth unless vibracore refusal was encountered. Vibracore refusal was defined as a penetration rate of less than 0.1 feet in 10 seconds. Sediment samples taken below the project depth were not included in the analyses.

In all, 130 sediment samples were collected for analyses as described below. All samples within the channel limits to overdepth were tested in accordance with ASTM D 422. The sieves typically used in the testing were the 3/4”, 3/8”, #4, #7, #10, #14, #18, #25, #35, #45, #60, #80, #120, #170, #200, and #230 sieves. Hydrometer analyses were not performed on materials passing the #230 sieve.

The color of the sediment from the Morehead City Harbor channel was not documented to a standard test procedure. However, during the winter of 2010 and 2011, dredged sediment from the Morehead City Outer Harbor was disposed of on the beaches of Fort Macon State Park and the Town of Atlantic Beach. In April 2011, Wilmington District staff walked the beach disposal areas and determined the color of the sediment by using the Munsell Color System. Eighteen (18) transects were sampled from Fort Macon State Park to the circle in the Town of Atlantic Beach. Spacing between transects was about 1,000 feet and 3 dry sediment samples per transect (from the mean high water contour, berm crest, and toe of dune) were color coded.

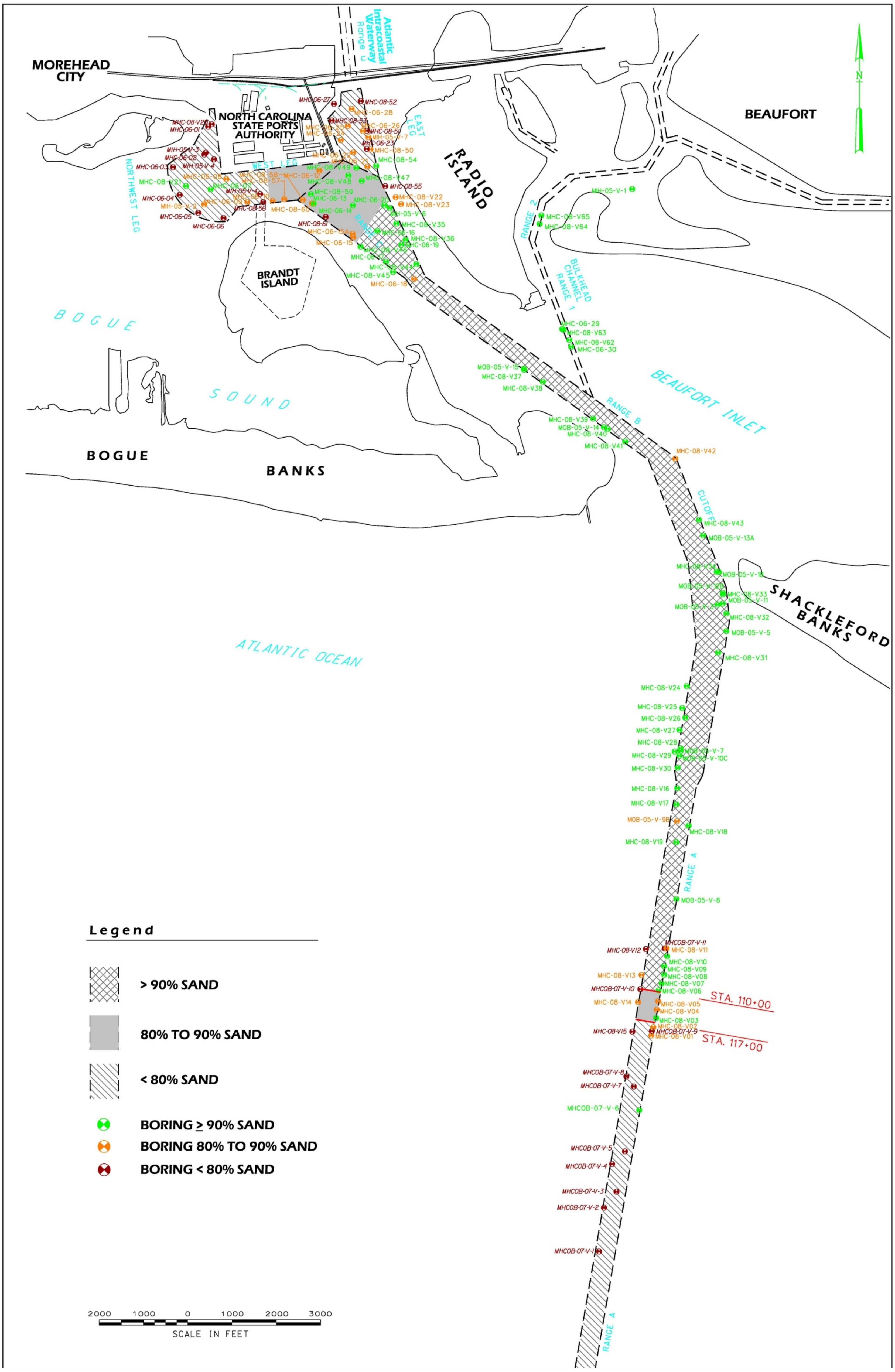


Figure 4-3. Morehead City Harbor Channel Sediment Characterization Boring Locations

Bogue Banks Beaches. During the summer of 2002, the Wilmington District characterized the beach sediment on Bogue Banks (USACE 2002b). A total of 525 sediment samples were taken (150 from the beach and 375 from the nearshore area to a depth of -24 feet) along 25 transects from Beaufort to Bogue Inlets (Figure 4-4). Spacing between transects was about 1 mile and there were 2 transects in Fort Macon State Park, 5 transects in Atlantic Beach, 6 transects in Pine Knoll Shores, 2 transects in Indian Beach/Salter Path, 7 transects in Emerald Isle, and 3 transects in the Bogue Inlet area.

In the foreshore area or beach area, six surface samples were collected from each of the 25 transect lines for a total of 150 samples. For each transect, one grab sample was collected from each of the following six locations:

1) seaward toe of the dune (DB);
2) crest of the berm (BC) approximately at elevation +7 NGDV;
3) mean high water (MHW), approximately at elevation +2.2 NGVD;
4) mean sea level (MSL), approximately +0.35 ft NGVD;
5) mean low water (MLW), approximately elevation -1.5 NGVD; and
6) at -3 NGDV.

The samples were collected from the top one to four inches of beach surface.

In the ocean, an average of 15 samples was collected from each of the 25 transect lines for a total of 375 samples. For each transect, one grab sample was taken at 2-foot increments of elevation beginning at elevation -4 NGVD through elevation -24 NGVD. The extra samples account for undulations of the ocean bottom. The samples were collected from the top one to four inches of ocean bottom.

All samples within the channel limits were tested in accordance with ASTM D 422. The hydrometer portion for the test procedure D 422 was not required for the material passing the Number 230 sieve. Classification of the samples was performed in accordance with ASTM D 2487. The sieves typically used in the testing were the 3/4", 3/8", #4, #7, #10, #14, #18, #25, #35, #45, #60, #80, #120, #170, #200, and #230 sieves.

The percent shell content of each sample was determined by estimating visually the amount of shell on each sieve, during the sieve procedure, to determine the overall sample shell content. Sediment color of these samples was not documented.

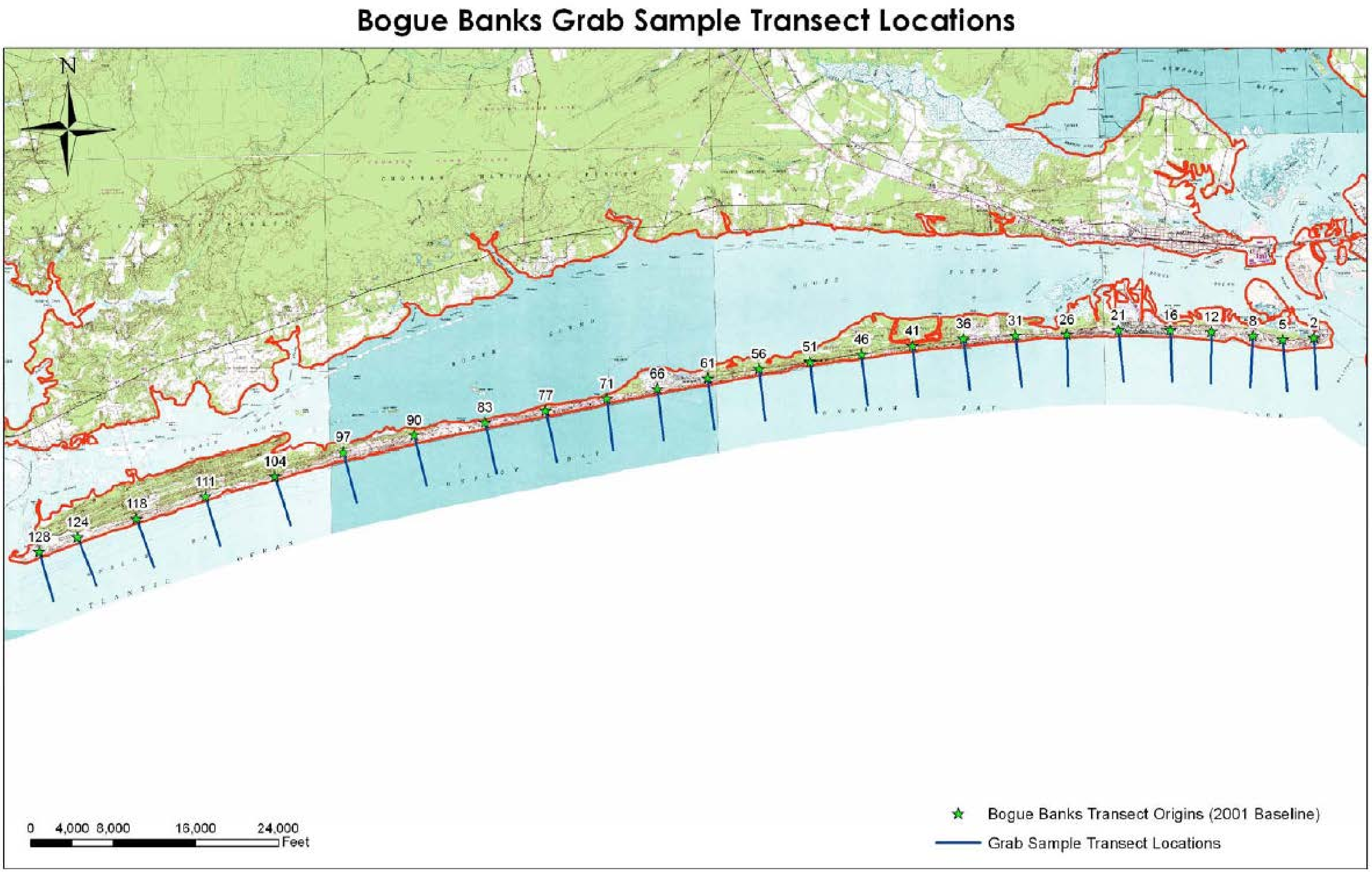


Figure 4-4. Bogue Banks Grab Sample Transect Locations

<u>Grain Size Analysis</u>. This section addresses grain size analyses and is summarized from the following sources: USACE 2002b, USACE 2008b, and USACE 2011.

Shackleford Banks. The 644 Shackleford Banks sediment samples collected illustrate the differences between the size-frequency distributions of sands from different zones on the beach. Grain size and sorting are useful parameters in explaining beach processes. The “beach” is a highly dynamic environment that is affected by a variety of forces including longshore currents, waves, wind, and offshore currents.

Table 4-1 divides the Shackleford sediments into broad zones: the dune to a depth of -24 ft offshore (the approximate depth of closure to wave impact); the dune base to -24 ft; the dune base to MLW; and the beach trough to -24 ft. All 644 grain size analyses were averaged after sorting into these data classes. The mean grain size ranged from 0.532 mm (dune base to MLW) to 0.250 mm (TR (trough) to -24 ft). The percent fines (passing the # 200 sieve (<0.074mm) was less than 2.0% for all data classes. The percent visual shell ranged from 8% for TR to -24 ft to 22% for DB to MLW. The Shackleford grain size frequency distributions summarized in Table 4-1 and are shown graphically in Figure 4-5. The distributions are unimodal.

Table 4-2 and Figure 4-6 present grain size data for Shackleford Banks native beach sediments summarized as a location mean from the 46 transects. Three groups of mean grain sizes are evident. The upper or mainly dry beach has grain sizes in the 0.300 to 0.360 mm range. The wet beach (MHW to the TR), with the sweeping oscillatory motion of the water in the breaker zone, has higher mean grain size (0.529 to 0.888 mm). Farther offshore (TR to – 30 ft) the mean grain size is smaller (0.167 to 0.261 mm). These data show a relationship between size frequency distribution of sands and the energy of specific portions of the beach. The percent visual shell results for Shackleford (Table 4-2) shows a direct relationship with mean grain size (mm). The shell content distribution is also a function of the environmental conditions at those locations on the beach profile. Another parameter provided in Table 4- 2 is the standard deviation in phi units. This indicates the degree of sorting in the sediments. Shackleford sediments are very well sorted on the dry beach, the dune (DN) to the berm crest (BC). The sediments in the more energetic wave area (MHW to TR) are only moderately well sorted (meaning the grain size distributions are less uniform – more varied). They become very well sorted again farther offshore (Bar to – 30 ft offshore).

Morehead City Harbor Dredged Material. Table 4-1 provides the mean grain size for 130 samples taken between 2005 and 2008 from cores of shoaled sediments within the authorized navigation channel. These cores were taken in areas that are acceptable for beach disposal. The mean grain size of the Morehead City Harbor dredged material composite was 0.267 mm. The percent fines (passing the # 200 sieve (<0.074mm) was 3.6%. The percent visual shell was 16%. The Morehead City Harbor dredged material composite grain size frequency distribution is shown graphically in Figure 4-5.

Bogue Banks. Table 4-1 presents results of sediment samples collected along Bogue Banks beach transects. The samples were collected at six locations along each transect. The locations were slightly different than those collected for Shackleford and did not include locations farther offshore (i.e., -6 to -30 ft NGVD). For comparison, the nearest representatives to the Bogue transect locations in the Shackleford data are the DB to -24 ft NGVD sample statistics.

The mean grain sizes for Bogue Banks ranged from 0.183 mm (Atlantic Beach) to 0.213 mm (Fort Macon). The percent fines (passing the # 200 sieve (<0.074mm) ranged from 1.6% to 3.6%. The percent visual shell estimates ranged from 4% to 10.9% for the Bogue Banks transect locations.

Sediment	No. of Samples	Mean mm	Std Dev phi	% Passing #200 sieve (0.074mm)	%Visual Shell
Morehead City Outer Harbor Channel*	130	0.267	0.84	3.6	16.0
Shackleford Banks DN to -24 ft	598	0.339	1.13	1.2	13.0
Shackleford Banks DB to -24 ft	552	0.344	1.20	1.3	13.9
Shackleford Banks DB to MLW	230	0.532	1.29	0.4	22.2
Shackleford Banks TR to -24 ft	322	0.25	0.88	1.9	8.0
Fort Macon	34	0.213	0.80	1.6	10.9
Atlantic Beach	82	0.183	0.79	3.4	7.1
Pine Knoll Shores	102	0.188	0.81	3.6	8.9
Indian Beach	34	0.205	0.93	3.2	10.9
East Emerald Isle	47	0.203	0.74	2.6	6.3
West Emerald Isle	67	0.193	0.68	2.4	4.9
Bogue Inlet Area	51	0.189	0.52	1.9	4.0

Table 4-1. Grain Size Comparison for the Morehead City Harbor Maintenance Sediment, Bogue Banks Sediment and Shackleford Banks Native Sediments. All sediment data taken from USACE 2002b, USACE 2008b, and USACE 2011. * Note: The Morehead City Outer Harbor Channel is a weighted average of the sediment samples.

		Average for all Transects			
Location on Shackleford Beach	No of Transects	phi	mm	Std (phi)	% Visual Shell
Dune (DN)	46	1.707	0.306	0.239	1.8
Dune Base (DB)	46	1.565	0.338	0.273	3.7
Berm Crest (BC)	46	1.479	0.359	0.313	5.7
Mean High Water (MHW)	46	0.711	0.611	0.612	26.5
Mean Sea Level (MSL)	46	0.179	0.883	0.725	39.5
Mean Low Water (MLW)	46	0.459	0.727	0.688	35.2
Trough (TR)	46	0.917	0.529	0.639	23.7
Bar (BR)	46	1.966	0.256	0.313	4.7
-6 NGVD	46	1.938	0.261	0.344	6.2
-10 NGVD	46	2.100	0.233	0.283	3.9
-12 NGVD	46	2.178	0.221	0.266	4.6
-18 NGVD	46	2.327	0.199	0.295	5.2
-24 NGVD	46	2.190	0.219	0.383	7.9
-30 NGVD	46	2.580	0.167	0.318	3.9

Sorting (from inclusive graphic standard deviation)	
very well sorted	under 0.35 phi
well sorted	0.35 to 0.50 phi
moderately well sorted	0.50 to 0.71 phi
moderately sorted	0.71 to 1.0 phi

Table 4-2. Summary of the Grain Size Data for Shackleford Banks Sediments Sorted by Position on Transect. All sediment data taken from USACE 2011.

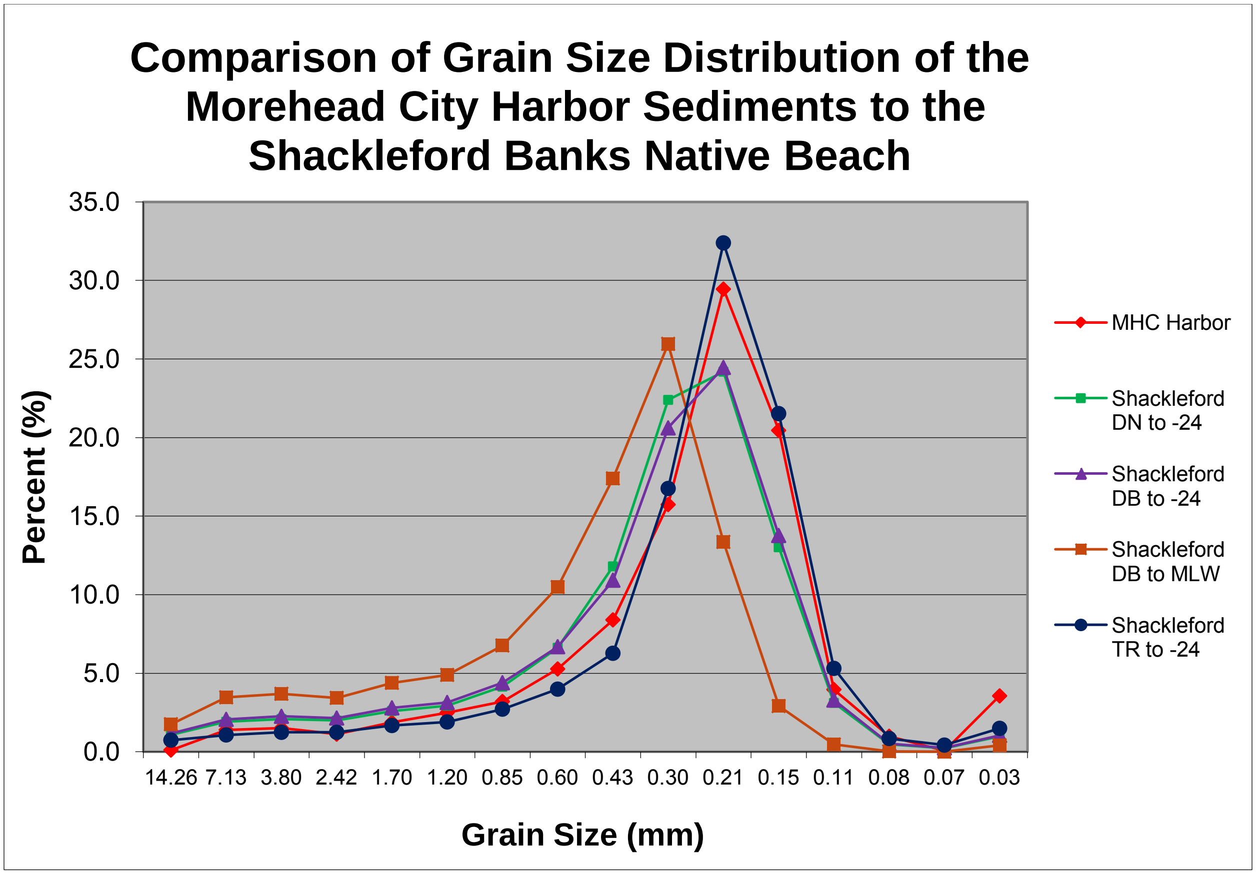


Figure 4-5. Grain Size Frequency Distribution - Shackleford Sediments Compared to the Dredged Material Composite Grain Size Frequency Distribution. Sediments from Shackleford collected May 2011 (USACE 2011) Distributions shown for Shackleford Banks are a composite (average) of 46 transects grouped by the locations on the beach profiles as shown. The distribution shown for Morehead City Harbor was obtained from 130 samples taken between 2005 and 2008 from cores of shoaled sediments within the authorized navigation channel.

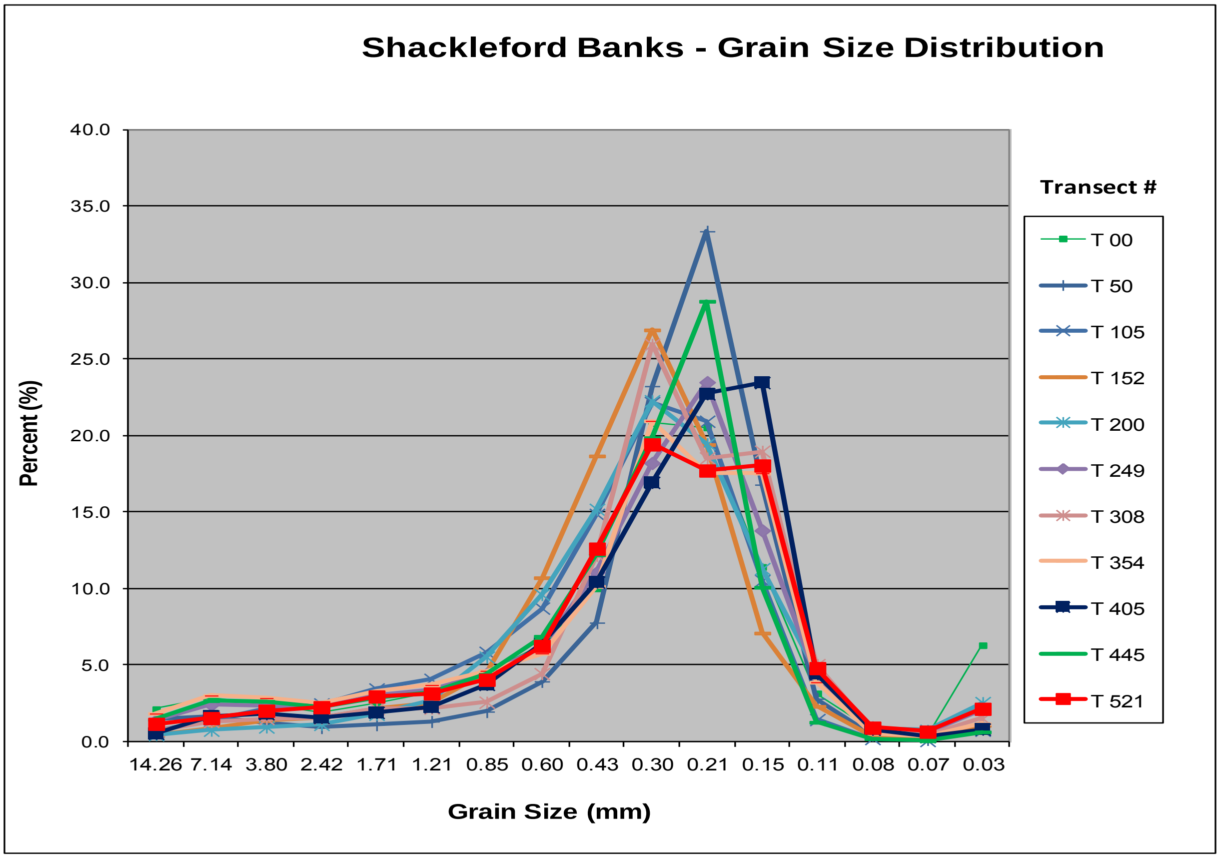


Figure 4-6. Grain Size Frequency Distribution of Shackleford Banks Sediments Collected May 2011 (USACE 2011). Distributions shown are composites or averages of all samples from the indicated transects which are spaced across the Shackleford Banks beach.

Sediment Color Analysis. The sediment color from the mean high water contour to the dune on Shackleford Banks (USACE 2011) along 46 transects was compiled and the color of the recently dredged maintenance sediment from the federal navigation channel disposed of on Bogue Banks at Fort Macon and Atlantic Beach (April 2011 site visit) was also determined from the mean high water contour to the bottom of the dune.

Table 4-3 summarizes these results and compares the color of the existing upland Shackleford Banks Beach to the sediment from the Morehead City Outer Harbor (Ranges A and B (including south Range C) and the Cutoff) that was recently disposed of (winter of 2011) along Fort Macon and Atlantic Beach.

All color sediment samples were identified using the "*Munsell Color System*". For example, Munsell defines **10 YR 7/2** as the following:

1. 10 YR is the hue or yellow red in this case (Munsell defines hue as "*the quality by which we distinguish one color from another*" and according to Munsell "*there are five principle colors: red, yellow, green, blue, and purple; and five intermediate colors: yellow-red, green-yellow, blue-green, purple-blue, and red-purple*"),

2. 7 is the value (i.e., lightness or brightness from 10 equals absolute white to 0 equals absolute black), and

3. /2 is the chroma or the difference from a pure hue to a gray shade (i.e., higher numbers represent stronger chromas or hues and lower numbers are grayer in color).

Shackleford Banks. Table 4-3, below, summarizes these results and compares the color of the existing upper Shackleford Banks beach (DN to MHW). The majority of the samples (172 out of 187) were 2.5Y 7/2 and 2.5Y 7/1.

Bogue Banks. The color of the recently dredged maintenance sediment from the Morehead City Harbor navigation channel placed on Bogue Banks (April 2011 site visit) is presented in Table 4-3. The dredged material disposed of on Bogue Banks was mostly 10 YR 7/1 and 10 YR 8/1.

As shown in Table 4-3 below, the predominant color of the upland Shackleford Banks beach (mean high water contour to the dune) is 2.5 Y 7/2 and the recently disposed Harbor dredged sediment on Bogue Banks is predominantly 10 YR 8/1. The difference between the 10 YR and 2.5 Y hues is that the 10 YR is slightly redder in color than the 2.5 Y. This means that the dredged maintenance sediment from the Harbor was slightly redder than the native Shackleford Banks sediment. Or the native Shackleford Banks beach was slightly more yellow in color than the sediment from Morehead City Harbor.

The value (i.e., brightness/lightness of the sediment) of the native Shackleford beach (7) was slightly darker than the dredged sediment (8) from Bogue Banks (from the Morehead City Harbor navigation channels), or the Bogue Banks sediment is slightly lighter (8 vs. 7) than the native Shackleford Banks beach.

The chroma of the dredged material (/1) disposed of on Bogue Banks was slightly grayer than the native Shackleford Banks beach (/2).

Shackleford Banks Beach Color (Overwash Area (OW) and Top of Dune (DN) to MHW line)

Hue	Value	Chroma	Number of Samples with this Munsell Color	% of Total Samples
10 YR	6	1	2	1%
10 YR	7	2	8	4%
2.5 Y	7	1	32	17%
2.5 Y	7	2	140	75%
2.5 Y	7	3	5	3%

Total samples measured 187

(includes 3 OW samples from transects 190, 415, and 435)

Fort Macon and Atlantic Beach Color (Dune Base (DB) to MHW line)

Hue	Value	Chroma	Number of Samples with this Munsell Color	% of Total Samples
10 YR	7	1	15	28%
10 YR	8	1	26	48%
10 YR	8	2	11	20%
10 YR	8	3	2	4%

Total Samples measured 54

Table 4-3. Munsell Color of Sediments from the Beaches of Shackleford Banks and Fort Macon State Park/Town of Atlantic Beach. Data taken from USACE (2011) and site visit dated April 2011 to Fort Macon State Park and the Town of Atlantic Beach.

The sediment color from the mean high water contour to the dune on Shackleford Banks (USACE 2011) along 46 transects was compiled and the color of the recently dredged material from the federal navigation channel disposed of on Bogue Banks (April 2011 site visit) was also measured. Table 4-3 summarizes these results and compares the color of the existing upland Shackleford Banks beach to the sediment from the Morehead City Outer Harbor (Ranges A and B (including South Range C) and the Cutoff) that was recently disposed of (winter of 2011) along Fort Macon and Atlantic Beach.

4.1.3 Sediment Composition in the Nearshore Placement Areas

In 2009, sediment grain size grab samples were taken at 96 locations within the existing nearshore placement area off Bogue Banks (Nearshore West) and the proposed nearshore area off of Shackleford Banks (Nearshore East). The purpose of this work was to characterize sediment particle size in these areas(USACE 2010b). Figure 4-7 shows the sediment sample locations off Bogue and Shackleford Banks.

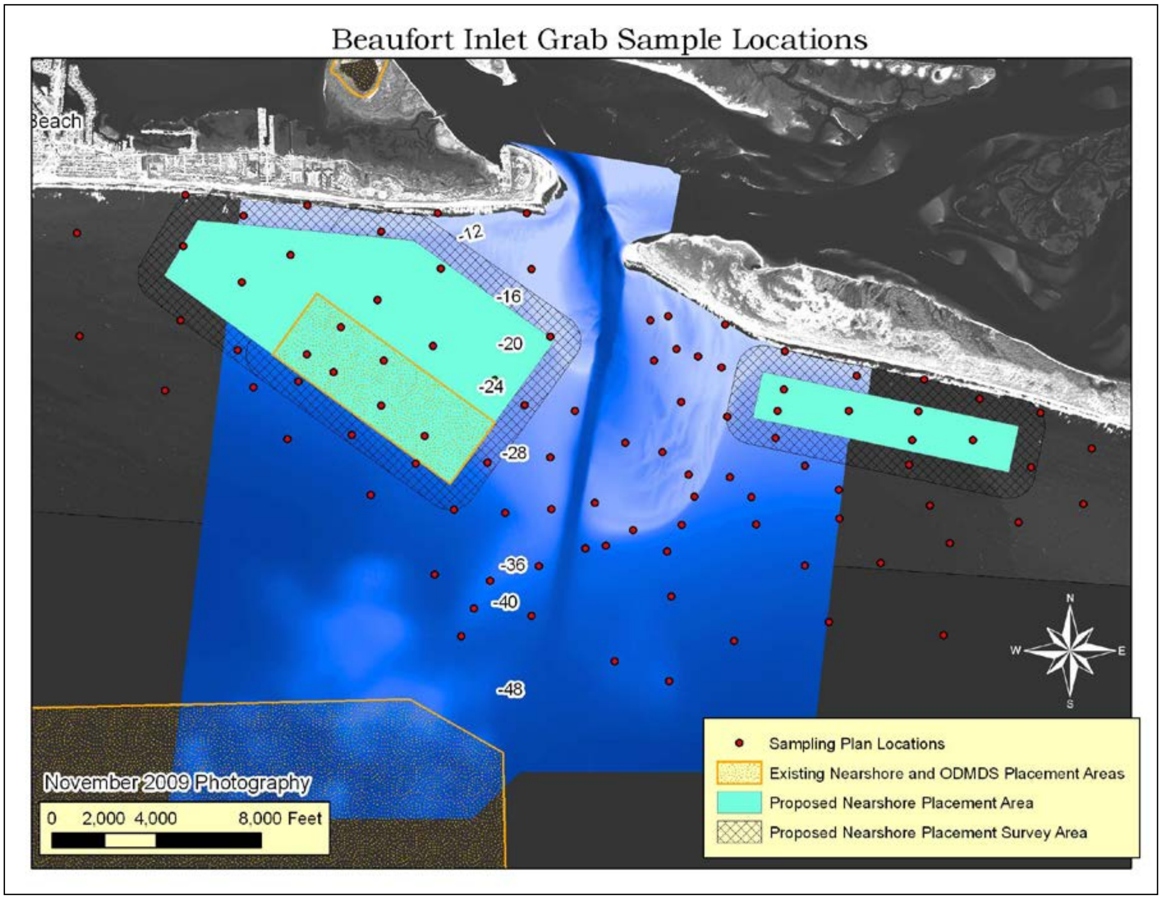


Figure 4-7. Sediment Sample Locations off Bogue Banks and Shackleford Banks

Out of the 96 sites sampled, 21.8% of the sites contained 10.3% to 61.0% silt/clay, and 42.7% had a low silt/clay content (<2% silt/clay). Areas of high silt/clay content (>10% and <61.0%) were found with one large group of sites occurring principally offshore of Shackleford Banks and several smaller areas offshore of Bogue Banks, in water depths ranging from ~20 to 49 feet. Areas of low silt/clay content (less than <2% silt/clay content) predominantly were found along the ebb tide delta and along the nearshore of Bogue and Shackleford Banks. A grouping of these stations also occurs offshore in ~40 feet of water. Three large groups of medium silt/clay content (>2 and <10% silt/clay content) occurred in the mid to nearshore of Shackleford Banks, offshore of the ebb tide delta, and in the mid to nearshore of Bogue Banks.

4.1.4 Sediment Contaminants

The Morehead City Harbor channel sediments that are coarse-grained are not likely to contain unacceptable levels of contaminants. These sediments meet the 40 CFR Part 227.13(b) criteria for compliance with the EPA Ocean Dumping Regulations and Criteria without further testing. The Morehead City Inner Harbor sediments that have significant silt and clay components do not meet Part 227.13(b) criteria for exclusion from further evaluation. Those sediments have been evaluated to determine acceptability for ocean disposal in accordance with EPA's Ocean Dumping Regulations and Criteria. The evaluations included Water Column (Part 227.6(c)(1) and 227.27(a)), Suspended Particulate Phase (Part 227.6(c)(2) and 227.27(b), and Benthic (Part 227.6(c)(2) and 227.27(b)) determinations.

Specific testing methods are described in Evaluation of Dredged Material Proposed for Ocean Disposal Testing Manual (USEPA/USACE 1991), hereafter referred to as the 1991 Implementation Manual (or Green Book) and the Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – Testing Manual, Inland Testing Manual (USACE/EPA 1998), hereafter referred to as the Inland Testing Manual (ITM). In addition, the Southeastern Regional Implementation Manual, Requirements and Procedures for Evaluation of the Ocean Disposal of Dredged Material in Southeastern U.S., Atlantic and Gulf Coastal Waters (USEPA/USACE 2008) provides further guidance on procedures to be followed when assessing the suitability of dredged material for ocean disposal. The testing manuals provide guidance to support the tiered-testing procedure for evaluating compliance.

The sampling design was closely coordinated with EPA, Region IV and included bulk sediment analyses, bioassays, and bioaccumulation evaluations. The results of these sediment evaluations are reported in *Evaluation of Dredged Material Proposed for Ocean Disposal, Morehead City Inner Harbor and USCG Station Fort Macon, North Carolina, September 2006* (USACE 2006). The test results indicate that the dredged materials resulting from dredging in the tested Morehead City Inner Harbor areas are acceptable for ocean disposal under Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972, as amended. This means that the sediments do not contain prohibited constituents other than trace contaminants.

The USEPA, Region 4 has concurred with all previous Section 103 evaluations. Periodic re-evaluations will be performed as required by EPA and USACE policy.

4.2 Hazardous and Toxic Materials

The North Carolina State Ports Authority (in NCSPA 2001) reviewed information, published by the United States Environmental Protection Agency (EPA), the North Carolina Department of Environment and Natural Resources (NCDENR), and E Data

Resources, Inc. (EDR) (an environmental database search firm). This review was used to determine if any known sites producing, storing, and/or disposing of toxic or hazardous materials have affected or have the potential to affect the Morehead City Harbor project area.

The EDR database search (EDR 2010) identified one site on Radio Island where a leaking underground storage tank (UST) was located. Two 1,000 gallon USTs were removed from the site in 1992. The tanks, which contained gasoline, had leaked, contaminating both the soil and groundwater. Contaminated soils were removed during excavation of the tanks. NCDENR records show that another 4,000 gallon gasoline UST, on Radio Island was removed in December, 1993. Possible petroleum contamination was observed in the soil around the tank. In March 1994 a monitoring well was installed in the tank excavation area and a groundwater sample obtained. However, the sample was below detectable limits for targeted petroleum related compounds.

Groundwater contamination is also documented at the site of the former Aviation Fuel Terminals, Inc. (AFT) facility on Radio Island. The AFT owned and operated a liquid bulk storage and handling facility for JP-4 and JP-5 jet fuels from 1953 to 1997. Aviation Fuel Terminal’s contracts for fuel storage ended in May 1997 and ten of the above-ground storage tanks (ASTs) have been empty since that time. The remaining 6 ASTs include 3 liquid fertilizer tanks, 2 liquid sulfur tanks and 1 sulfuric acid tank.

Jet fuel contamination associated with past practices at the tank farm and loading rack was discovered in 1999 during a Phase II Site Assessment. This was followed by the preparation of a Comprehensive Site Assessment Report (CSA) in July 1999. At present there are 54 on-site and 7 off-site groundwater monitoring wells. The CSA reported that petroleum related compounds had been detected in both soil and shallow groundwater.

Three Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) sites are within a four-mile radius of the Morehead City Harbor port facility center (EDR 2010). The file information found for these sites was cursory with no activities initiated by the NC Superfund or the Inactive Hazardous Sites Branch within the past eight years. The US Coast Guard Fort Macon Station (NC5690308262) is located at Atlantic Beach, 0.6 miles south of Radio Island. It was removed from the CERCLIS list and the Inactive Hazardous Sites Branch gave it a status of No Further Action. The National Marine Fisheries Service (NC3131430180) is located in Beaufort on Pivers Island Road, 0.5 miles east of the project site. It has a status of No Further Remedial Action Planned under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and No Further Action status under the State’s Inactive Hazardous Sites Branch. The US Army Reserve XVIII Airborne Corps (NC5210022906) on Fisher Street in Morehead City is 1.1 miles northeast of the project. It has a federal status of No Further Remedial Action Planned and No Further Action under the State’s Inactive Hazardous Sites Branch.

4.3 Water Resources

4.3.1 Water Quality

Sensitive aquatic systems within the Morehead City Harbor project area (Atlantic Ocean, Newport River, Bogue Sound, and Back Sound around Cape Lookout National Seashore that may be affected by water quality include submerged aquatic vegetation and associated fauna, marshes, and nektonic communities (fish, shellfish, and marine reptiles and mammals). The following section describes existing water quality conditions that have a direct impact on these aquatic systems.

Morehead City Harbor is located within the confluence of the Newport River and Bogue Sound. Tides are semi-diurnal (two tidal cycles per day), and the average tidal range from mean high to mean low in Morehead City Harbor is about 3.1 feet (NOAA 2011).

Salinity concentrations in the navigation channel through Beaufort Inlet are near sea strength (Salinity greater than 34 parts per thousand) and range from 29.0 parts per thousand (ppt) to 34.5 ppt depending on the sample location, tidal cycle and freshwater discharge (Churchill et al. 1999).

The Newport River watershed (subbasin 03-05-03) is located just east of the White Oak River. It flows into the eastern end of Bogue Sound before entering the Atlantic Ocean near Morehead City. There are 74 stream miles, 34,445 estuarine acres and 25 miles of Atlantic coastline in this subbasin (NCDENR 2007).

Bogue Sound is the body of shallow water to the north of Bogue Banks, separating the barrier island from the mainland of Carteret County. The Sound is bordered by Bogue Inlet and the White Oak River to the west and Beaufort Inlet and the Newport River to the east. The Atlantic Intracoastal Waterway (AIWW) traverses the northern portion of Bogue Sound in an east-west orientation. Salinity varies in the Sound, with the highest levels (about 34 ppt) closest to the two inlets where the tidal influence is strongest. The North Carolina Division of Water Quality (NC DWQ) has designated Bogue Sound as having Outstanding Resource Waters (ORW) due to their high quality.

Bogue Sound also provides diverse aquatic resources. Over 6100 acres of SAV were located in the sound in 1988 or 1993 (NOAA 2002). These beds have been designated as Essential Fish Habitat (EFH) by the South Atlantic Fishery Management Council (SAFMC) for their high value to blue crab (*Callinectes sapidus*), juvenile fish, and shrimp (*Penaeus* sp.). All five species of sea turtles found in North Carolina waters (Epperly et al. 1995) and the West Indian manatee (*Trichechus manatus*), all federally-protected species, may forage in Bogue Sound during warmer summer months. As herbivorous and/or omnivorous species, these aquatic species forage upon SAV beds for nourishment.

The sound is of moderate size for North Carolina (with a maximum fetch of ~23 miles), larger than any open-water sound to the south but covering less area than Albemarle or

Pamlico Sounds to the north (which have maximum fetches of 30-70 miles). The southern portion of the sound along Bogue Banks contains several areas of sand shoals and *Spartina* spp. marsh. Shellfish beds and submerged aquatic vegetation (SAV) occur throughout the sound. Comparatively deeper waters allow navigational use and transport of larval stages of fishery resources.

Back Sound is part of the Albemarle-Pamlico (AP) estuary system, which is the second largest estuary in the United States, draining a watershed of approximately 30,000 square miles. The AP estuary encompasses over 9,000 miles of freshwater rivers and streams and over 1.5 million acres of brackish, estuarine waters. There are five major river basins (Chowan, Roanoke, Pasquotank, Tar-Pamlico, and Neuse) that flow into the Albemarle-Pamlico system.

Back Sound is very shallow in most areas adjacent to the CALO, averaging only 1 to 2 feet in depth at low tide. Tides are semi-diurnal (two tidal cycles per day), and the mean tidal range at Cape Lookout is 3.7 feet (NOAA 2005), so the maximum depth of park waters is approximately 6 feet. There are navigational channels through the Core and Back Sounds, but these channels are only 5 to 10 feet deep. High tidal flushing occurs around the Beaufort and Ocracoke Inlets because they exceed 20 feet in depth, allowing tidal currents to reach speeds up to four knots (NOAA 2005). With Barden Inlet only 10 feet deep and New Drum Inlet even shallower, the sound side of the North and South Core Banks has low tidal flushing.

The Albemarle-Pamlico estuary system has seasonal salinity cycles, with the highest salinity occurring from September to November, the lowest from February to April (NOAA no date). During periods of high salinity, waters adjacent to the national seashore in Core and Back Sounds can have a salinity greater than 25 parts per thousand (ppt). During low salinity periods, waters in Back Sound adjacent to the eastern half of Shackleford Banks and waters in Core Sound adjacent to North Core Banks have an average salinity of 15 to 25 ppt. Annual ocean water temperatures off of the Outer Banks ranges from approximately 50° to 80°F (NOAA no date).

Core Sound is classified by the North Carolina Department of Environment and Natural Resources, Division of Water Quality as High Quality Waters, a classification intended to protect waters with quality higher than State water quality standards. There are associated wastewater treatment and development controls for High Quality Waters enforced by the State. Core Sound is also designated as Outstanding Resource Waters, a classification intended to protect unique and special waters having excellent water quality and being of exceptional state or national ecological or recreational significance. No new or expanded wastewater discharges are allowed into Outstanding Resource Waters, and there are associated watershed stormwater controls enforced by the state.

Because the islands of Cape Lookout National Seashore are a mile or more from the mainland, and are undeveloped, the water quality has not been significantly impacted by human activities (NCDENR 2007). The primary pollution sources include mainland urban stormwater and agricultural runoff, effluent from sewage treatment plants and septic systems, recreational boating and marinas, and commercial shipping. Due to the proximity to the Intracoastal Waterway, Morehead City, and Beaufort, waters near Beaufort Inlet have heavy ship and boat traffic.

The Environmental Protection Agency has developed national recommended water quality criteria for priority pollutants in ambient water for the protection of aquatic life and human health (EPA 2002). These criteria have been adopted as enforceable standards by most states. The Clean Water Act and federal Pollution Control Act regulate and protect all national waters. Under these laws all states must submit a 305(b) report, which characterizes the quality of their waters on a watershed level, and a 303(d) list, which establishes which specific water bodies do not meet the federal or state water quality standards for its designated use(s). The watersheds are rated as follows:

- Category I: Watersheds are in need of restoration and do not meet clean water and natural resource goals.
- Category II: Watersheds are meeting goals and may need action to maintain standards.
- Category III: Watersheds have pristine or sensitive aquatic conditions (most of these are designated as wilderness, wild and scenic rivers, or outstanding natural resource waters).
- Category IV: Watersheds do not have sufficient data to make an assessment.

The Clean Water Act requires that the surface waters of each state be classified according to designated uses. North Carolina's tidal salt waters are classified with the following categories:

- Class SC: Secondary Recreation and Aquatic Life Propagation
- Class SB: Primary Recreation plus SC uses
- Class SA: Shellfishing for Market Purposes plus SC/SB uses
- HQW: High Quality Water

If a waterbody does not meet the state designated use standards, it is considered impaired and is placed on the 303(d) list. North Carolina's 303(d) list of impaired waters includes the waters of Core Sound as impaired due to fecal coliform bacteria with possible sources including septic systems, marinas, urban runoff, and agriculture (NCDENR 2007). Atlantic Ocean waters are listed as impaired due to a mercury fish advisory. Waters in Core Sound are Class SA, suitable for shellfishing for market purposes as well as primary and secondary recreation, and aquatic life propagation. All SA waters are by definition also High Quality Waters, and, as previously mentioned, Core Sound is designated as Outstanding Resource Waters because of its exceptional ecological significance. Table 4-4 summarizes the waterbody classifications in the DMMP project area.

Waterbody	Watershed	State Use Designation	303(d) Listed Impairment	federal Designation: EPA Watershed Category
Newport River	White Oak River Basin (subbasin 03-05-03)	Class SA HQW	Fecal Coliform	Category II
Bogue Sound	White Oak River Basin	Class SA HQW	Fecal Coliform	Category II
Back/Core Sounds	Bogue-Core Sounds (03020106)	Class SA	Fecal Coliform	Category II
Atlantic Ocean	Bogue-Core Sounds (03020106)	Class SB	Fish Advisory-Mercury	Category II

Table 4-4. Waterbody Classifications at Morehead City Harbor (NCDENR 2007, EPA 1998)

4.3.2 Groundwater

Groundwater on Bogue and Shackleford Banks occurs in an unconfined sand aquifer, an upper confined aquifer, and a lower confined aquifer. The unconfined aquifer (freshwater lens) in areas occupied by dunes will yield as much as 30 gallons per minute of freshwater to a horizontal well. In other parts of the seashore this aquifer is subject to periodic overwash from the ocean, thus temporarily contaminating it with saltwater. Some high dunes on Shackleford Banks and Bogue Banks offer some protection from overwash to the unconfined aquifer. Any lowering of the water table will cause a rise of the saltwater/freshwater interface. The upper confined aquifer, which occurs between depths of about 90 to 150 feet, is known to contain freshwater only in the New Drum Inlet area and at Harkers Island. The potential yield of this aquifer is unknown, but probably does not exceed 10 to 15 gallons per minute (NCDENR 2007).

The lower confined aquifer, which occurs between depths of 150 and 550 feet, contains freshwater. Potential yield is estimated to be as much as 500 gallons per minute per well. The estimated freshwater yield from all aquifers depends on the position of the saltwater interface at any site. Water samples from the seashore generally meet drinking water standards set by the U. S. Environmental Protection Agency although some samples contained excess concentrations of chloride, iron, and manganese. Excessive chloride in the area is indicative of the presence of saltwater. Excessive iron and manganese occur naturally in some groundwater and may also be dissolved from well casings or pumping equipment (NCDENR 2007).

Groundwater is plentiful throughout the county. It is near the surface in most places, particularly during the winter and early spring. Thousands of feet of sedimentary deposits underlie the area. The upper part of these deposits contains aquifers that supply water for domestic use. The surficial aquifer ranges from near the surface to a maximum depth of 75 feet. It is thickest east of Morehead City. Early in the development of the County, the main source of domestic water was from shallow wells in this aquifer. The use of shallow wells has decreased considerably because of the small yield in some places, the high content of dissolved iron in the water, and the risk of contamination. The underlying limestone of the Yorktown or Castle Hayne Formations, or both, is a more productive artesian aquifer and is the main source of water supply in the County today. The water is generally hard, but low in iron. Water from wells near the coast and especially on the Outer Banks may be salty, but layers of fresh groundwater are at lower depths

4.4 Air Quality

The Wilmington Regional Office of the North Carolina Department of Environment and Natural Resources has air quality jurisdiction for the project area. The ambient air quality for Carteret County has been determined to be in compliance with the National Ambient Air Quality Standards, and this County is designated as an attainment area (Personal Communication, Brad Newland, Engineer, NC Division of Air Quality, 26 November 10).

4.5 Marine and Estuarine Resources

4.5.1 Nekton

Nekton collectively refers to aquatic organisms capable of controlling their location through active movement rather than depending on water currents or gravity for passive movement. Nekton of the nearshore Atlantic Ocean along Bogue and Shackleford Banks, North Carolina, can be grouped into three categories: estuarine dependent species, permanent resident species, and seasonal migrant species. The most abundant nekton of these waters are the estuarine-dependent species, which inhabit the estuary as larvae and the ocean as juveniles or adults. That group includes species that spawn offshore, such as the Atlantic croaker (*Micropogon undulatus*), spot (*L. xanthurus*), Atlantic menhaden (*B. tyrannus*), star drum (*Stellifer lanceolatus*), southern kingfish (*Menticirrhus americanus*), flounders (*Paralichthys* spp.), mullets (*Mugil* spp.), anchovies (*Anchoa* spp.), blue crab (*Callinectes sapidus*), and penaeid shrimp (*Farfantepenaeus* spp. and *Lilopenaeus* sp.), as well as species that spawn in the estuary, such as red drum (*Sciaenops ocellatus*) and weakfish (*Cynoscion regalis*). Species that are permanent residents of the nearshore marine waters include the black sea bass (*Centropristis striata*), longspine porgy (*Stenotomus caprinus*), Atlantic bumper (*Chloroscombrus chrysurus*), inshore lizardfish (*Synodus foetens*), and searobins (*Prionotus* spp.). Common warm water migrant species include the bluefish (*Pomatomus saltatrix*), Spanish mackerel (*Scomberomorus maculatus*), king mackerel (*Scomberomorus cavalla*), cobia (*Rachycentron canadum*), Florida pompano (*T.*

carolinus), and spiny dogfish (*Squalus acanthias*). Oceanic large nekton offshore of Bogue and Shackleford Banks are composed of a wide variety of bony fishes, sharks, and rays, as well as fewer numbers of marine mammals and reptiles.

4.5.2 Benthic Resources - Beach and Surf Zone

The intertidal zone of the beach shoreface is extremely dynamic and is characterized as the area from mean low tide landward to the high tide mark. Figure 4-8 shows a typical beach cross section for proposed beach disposal of maintenance dredged material. The intertidal zone serves as habitat for invertebrate communities adapted to the high-energy, sandy-beach environment. Important invertebrates of the surf zone and beach/dune community include the mole crab (*Emerita talpoida*), coquina clams (*Donax variabilis*), polychaete worms, amphipods, and ghost crabs (*Ocypode quadrata*). Mole crabs and coquinas represent the largest component of the total macrofaunal biomass of North Carolina intertidal beaches, and they are consumed in large numbers by important fish species such as flounders, pompanos, silversides, mullets, and kingfish (Reilly and Bellis 1978; Leber 1982; Johnson 1994). Beach intertidal macrofauna are also a seasonally important food source for numerous shorebird species.

Through recent studies supported by the U.S. Fish and Wildlife Service (USFWS) and the USACE, the distributions and abundance of these animals on nearby beaches is fairly well documented. Extensive sampling of the intertidal and nearshore beach environment was performed and documented in the USACE', New York District's biological monitoring report titled, *Final Report for The Army Corps of Engineers New York District's Biological Monitoring Program for the Atlantic Coast of New Jersey, Sea Bright to Manasquan Inlet, Beach Erosion Project* (USACE 2001a). Results of that study indicate that the intertidal infaunal assemblage was dominated by rhynchocoels; the polychaetes *Scolelepis squamata*, *Protodriloides (LPIL)*, and *Microphthalmus* spp.; oligochaetes; the mole crab *E. talpoida*; and a number of haustoriid amphipods. The nearshore infaunal assemblage included many of the same taxa but was dominated by the wedge clam, *D. variabilis*, the polychaete *Magelona papillicornis*, the clams *Spisula solidissim*a and *Tellina agilis,* and the amphipods *Acanthohaustorius millsi* and *Psammonyx nobilis*, and the polychaete *Asabellides oculata*. Those documented infaunal assemblages are consistent with other studies throughout the Atlantic Coast (USACE 2001a). In North Carolina, including the project area, infaunal assemblages are dominated by *D. variabilis*, *D. parvula*, and *E. talpoida*, which function as an important first link in the flow of energy in the intertidal system (Leber 1982; Reilly and Bellis 1978). Other organisms occurring less frequently are Amphipods (*Haustorius canadensis, Talorchestia megalopthalma*, and *Amphiporia virginiana*) and Polychaetes (*S. squamata* and *Nephtys picta*) (Lindquist and Manning 2001; Nelson 1989; Leber 1982; Reilly and Bellis 1978).

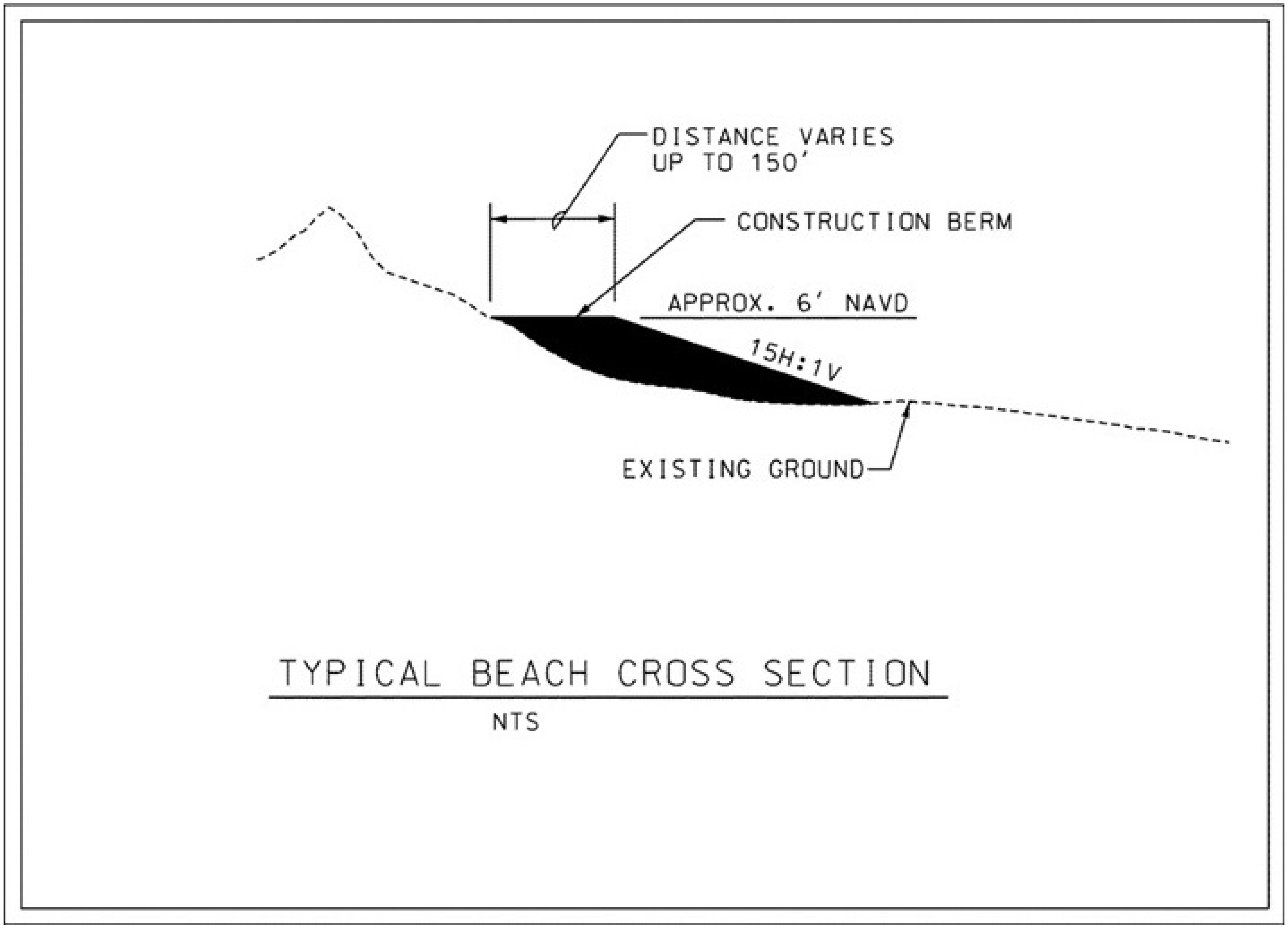


Figure 4-8. Typical Beach Cross Section from Dune Base to about -24 foot depth (Not to Scale).

4.5.3 Benthic Resources - Nearshore Ocean

The following is taken from the North Carolina Coastal Habitat Protection Plan (Deaton et al. 2010).

Offshore sand bottom communities along the North Carolina coast are relatively diverse habitats containing over a hundred polychaete taxa (Lindquist et al. 1994; Posey and Ambrose 1994). Tube dwellers and permanent burrow dwellers are important benthic prey for fish and epibenthic invertebrates. These species are also most susceptible to sediment deposition, turbidity, erosion, or changes in sediment structure associated with sand mining activities, compared to other more mobile polychaetes (Hackney et al. 1996). In South Carolina, 243 species of benthic invertebrates were documented in the nearshore subtidal bottom (Van Dolah et al. 1994). Polychaetes and amphipods were the most abundant, although oligochaetes, bivalves, and crabs were also highly represented (Van Dolah et al. 1994). On ebb tide deltas, polychaetes, crustaceans (primarily amphipods), and mollusks (primarily bivalves) were the most abundant infauna, while decapod crustaceans and echinoderms (sand dollars) dominated the epifauna. Because periodic storms can affect benthic communities along the Atlantic coast to a depth of about 115 ft (35 m), the soft bottom community tends to be dominated by opportunistic taxa that are adapted to recover relatively quickly from disturbance (Posey and Alphin 2001). Many faunal species documented on the ebb tide delta are important food sources for demersal predatory fishes and mobile crustaceans, including spot, croaker, weakfish, red drum, and penaeid shrimp. These fish species congregate in and around inlets during various times of the year (Peterson and Peterson 1979), presumably to enhance successful prey acquisition and reproduction.

Benthic communities approximately 2 miles inshore of the Morehead City ODMDS were sampled by Peterson and Wells (2000) as a part of the nearshore placement monitoring. The stations were arranged in a grid of three transects with three stations on each transect at the 19-, 26-, and 36-foot isobaths. Taxa in order of abundance included polychaetes, annelids, bivalve mollusks, amphipod crustaceans, echinoderms, and nematodes. The total density of infaunal invertebrates ranged from 5-14 per 76 cm^2 and total densities of larger epifaunal invertebrates ranged from 3 to 43 individuals per 10 m^2. This sampling is thought to be representative of those occupying this environment over a broad geographic area.

The USACE collected sediment and macroinvertebrate samples at 96 stations (Figure 4-7) in the vicinity of the Beaufort Inlet ebb tide delta in September 2009 (USACE 2010b). Benthic community characterizations and sieve analysis were performed on the sediment samples. A report was compiled describing the methods and results of biological and sediment sampling conducted at the 96 sample locations. The report includes (1) a description of macroinvertebrate community and sediment conditions, (2) a compilation of sediment and macroinvertebrate sampling results; and (3) spatial analyses of similarities and differences between sample sites. The report is summarized in the paragraphs which follow.

Benthic Community. A total of 7,053 organisms representing 260 taxa were identified from 95 samples. Polychaetes were the most numerous organisms, representing 43.9 percent of the total assemblage, followed by malacostracans (primarily amphipods) at 25.7 %, bivalves (10.5 %) and gastropods (10.0 %). The number of taxa per station ranged from 1 to 57. Station densities ranged from 9.1 organisms/m2 to 4,609 organisms/m2.

Similarity Determinations. Clustering of stations based on sediment and macroinvertebrate species populations and assemblages was evident through spatial analysis. The data suggest that the nearshore site showing the closest correlation and strongest relationships between sample sites is located offshore of Shackleford Banks. This area has medium silt/clay content and benthic species diversity and richness values are moderate to high. The shallow water depths cause the benthic environment to be influenced by scour and sediment resuspension caused by wave action and tidal currents.

4.5.4 Surf Zone Fishes

The surf zone along the area beaches provides important fishery habitat on which some species are dependent. Surf zone fisheries are typically diverse, and 47 species have been identified from North Carolina; however, the actual species richness of fishes using the North Carolina surf area for at least part of their life history is much higher (Ross 1996; Ross and Lancaster 1996). According to Ross (1996), the most common species in the South Atlantic Bight surf zone are Atlantic menhaden (*Brevoortia tyrannus*), striped anchovy (*Anchoa hepsetus*), bay anchovy (*A. mitchilli*), rough silverside (*Membras martinica*), Atlantic silverside (*Menidia menidia*), Florida pompano (*Trachinotus carolinus*), spot (*Leiostomus xanthurus*), Gulf kingfish (*Menticirrhus littoralis*), and striped mullet (*Mugil cephalus*). Two species in particular, the Florida pompano and gulf kingfish (*M. littoralis*) seem to use the surf zone exclusively as a juvenile nursery area and are rarely found elsewhere. The major recruitment time for juvenile fishes to surf zone nurseries is late spring through early summer (Hackney et al. 1996). Recent studies by Ross and Lancaster (1996) indicate that the Florida pompano and gulf kingfish may have high site fidelity to small areas of the beach and extended residence time in the surf zone, suggesting its function as a nursery area. Major surf zone species consume a variety of benthic and planktonic invertebrates, with most of the prey coming from the water column. The dominant benthic prey are coquina clams; however, that is not the dominant food item throughout the South Atlantic Bight. Furthermore, many surf zone fishes exhibit prey switching in relation to prey availability, which could mitigate effects of beach disposal (Ross 1996).

4.5.5 Larval Fishes

Beaufort Inlet is an important passageway for the larvae of many species of commercially or ecologically important fish. Spawning grounds for many marine fishes are believed to occur on the continental shelf with immigration to estuaries during the juvenile stage. The shelter provided by the marsh and creek systems in the sound serves as nursery habitat where young fish undergo rapid growth before returning to the offshore environment.

Transport from offshore shelves to estuarine nursery habitats occurs in three stages: offshore spawning grounds to nearshore, nearshore to the locality of an inlet or estuary mouth, and from the mouth into the estuary (Boehlert and Mundy 1988). Hettler et al. (1997) documented, through analysis of larvae otoliths, that a large number of young Atlantic menhaden (*B. tyrannus*) larvae averaging 55 days post hatch arrived in mid-March on the date of maximum observed daily concentration (160 larvae per 100 cubic meters (m^3)(3,531 cubic feet [ft^3]). For all species recorded in this study, abundance varied as much as an order of magnitude from night to night. The methods the larvae use to traverse large distances over the open ocean and find inlets are uncertain. Various studies have hypothesized such mechanisms as passive wind and depth-varying current dispersal and active horizontal swimming transport. However, little is known regarding larval distribution in the nearshore area.

The Beaufort Inlet system has been extensively studied, and significant amounts of data have been collected regarding larval transport of commercially and ecologically important fish. During the winters of 1992–1993 and 1993–1994, Hettler and Hare (1998) conducted an experiment at Beaufort Inlet, North Carolina, to further understand the estuarine ingress of offshore spawning species. A complex lateral structure in estuarine circulation, independent of the inlet opening size, was found in regards to larval concentration with significant interactions among inlet side, distance offshore, and date of ichthyoplankton tows. Length of species caught varied by cruise, inlet side, and distance offshore. The differences in larval concentration offshore and inshore and the species differences in length suggest species-specific rates controlling the net number of larvae entering the nearshore from offshore, the net number of larvae entering the inlet mouth from nearshore, and the larval mortality in the nearshore zone. Results from the study suggest two bottlenecks for offshore-spawning fishes with estuarine juveniles: the transport of larvae into the nearshore zone and the transport of larvae into the estuary from the nearshore zone (Hettler and Hare 1998).

Egg and larval transport from offshore spawning grounds to the inshore environment of Beaufort Inlet was studied by Hettler and Hare (1998) in seven estuarine-dependent species, including Atlantic menhaden (*B. tyrannus*), spot (*L. xanthurus*), Atlantic croaker (*Micropogonias undulatus*), pinfish (*Lagodon rhomboides*), summer flounder (*Paralichthys dentatus*), southern flounder (*P. lethostigma*) and Gulf flounder *(P. albigutta*). Research conducted by the NMFS Beaufort Laboratory through June 2002 collected a total of 120 species of larval fish fauna off the Beaufort Inlet and adjacent waters. According to Hettler and Hare (1998), average weekly concentration (number per 100 m^3 (3,531 ft^3)) for all of the above estuarine dependent species, with the exception of Gulf flounder, was calculated during the October 1994 to April 1995 immigration season. Concentrations were 22.9, 4.8, 25.7, 12.4, 0.3, and 0.8 larvae/100m^3 (3,531 ft^3) respectively (Hettler 1998). According to the spring tide flow calculated by Jarrett (1976) and the calculated daily larval concentration within the water column, approximately 32.5, 6.8, 36.5, 17.6, 0.43, and 1.1 million larvae pass through the inlet during a single spring tide for each respective species. Concentrations for all species combined entering the inlet during a single tidal prism range from 0.5 to 5 larvae/m^3. Therefore, daily calculated larval concentration at Beaufort Inlet for all species within the tidal prism ranges between 66 to 710 million (Larry Settle, personal communication, June 27, 2002).

4.5.6 Hardbottoms

Of special concern in the offshore area are hardbottoms, which are localized areas, not covered by unconsolidated sediments and where the ocean floor is hard rock. Hardbottoms are also called "live bottoms" because they support a rich diversity of invertebrates such as corals, anemones, and sponges, which are refuges for fish and other marine life. They provide valuable habitat for reef fish such as black sea bass, red porgy, and groupers. Hardbottoms are also attractive to pelagic species such as king mackerel, amberjack, and cobia. Along the North Carolina coast, hard bottoms are most abundant in southern portion of the state. Review of data provided by the Southeast Monitoring and Assessment Program (SEAMAP 2001) and the results of surveys from Tidewater and Geo-Dynamics identified one area of hardbottom off Pine Knoll Shores, about 2 miles south of the project area.

To assess potential beach nourishment impacts from the Bogue Banks Shore Protection Project (BBSPP) to hardbottom resources in the nearshore environment off of Bogue Banks, North Carolina, the U.S. Army Corps of Engineers initiated ground-truthing investigations of potential hardbottom habitat within and adjacent to the project area (USACE 2009). The study area was located in the nearshore environment off Bogue Banks, North Carolina, between Bogue Inlet and Beaufort Inlet. Previously conducted sidescan sonar surveys of this area identified possible seafloor morphology of interest between 250 feet and 2500 feet from shore and between the -5 to -30-foot NGVD water depth contours (Greenhorne and O'Mara, 2007). This area is located on and/or within the limits of the calculated -25-foot NVGD depth of closure identified for the BBSPP. To assess potential beach nourishment impacts to hardbottom resources, USACE required ground-truth investigations of potential hardbottom within and adjacent to the BBSPP.

Ground-truth verification was completed on January 21 and 22, 2009 (USACE 2009b). The ground-truthing surveys conducted during the course of this investigation inshore of the depth of closure found only fine sand where prior sidescan sonar interpretations suggested other seafloor morphologies of interest. The explanation for this discrepancy is that sand movement within the depth of closure along a beach profile is well established and can be proven to have occurred through an examination of historic beach profiles. Although it is logical to assume sand movement inside the depth of closure, which is documented, it is the conclusion of this investigation that no hardbottom resources are present within the area surveyed by Geodynamics (Greenhorne and O'Mara, 2007). This conclusion is based on four primary factors:

(1) A re-analysis and interpretation of sidescan sonar data concluded that no signatures indicative of hardbottom habitats existed in the survey area.

(2) Ground-truthing operations confirmed sidescan sonar interpretation of seafloor morphologies of interest,

(3) No hardbottom was found during ground-truthing operations.

(4) An analysis of historic beach profiles along Bogue Banks (Moffat and Nichol, 2008) does not suggest any rock outcrops along beach profiles.

Additional side-scan sonar surveys within the proposed Shackleford Banks nearshore placement area and the proposed expanded Nearshore West revealed no evidence of hardbottoms. (USACE 2010a).

4.5.7 Essential Fish Habitat

Table 4-5 shows the categories of EFH and Habitat Areas of Particular Concern (HAPC) for managed species, which were identified in the Fishery Management Plan Amendments affecting the South Atlantic area pursuant to implementing the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). Table 4-6 lists the federally managed fish species of North Carolina for which Fishery Management Plans have been developed by the South Atlantic Fishery Management Council (SAFMC), Mid-Atlantic Fishery Management Council (MAFMC), and National Marine Fisheries Service (NMFS). In addition, Table 4-6 shows EFH by fish life stage and ecosystem type for those species that have designated EFH. The fish species and habitats shown in these tables require special consideration to promote their viability and sustainability.

ESSENTIAL FISH HABITAT	GEOGRAPHICALLY DEFINED HABITAT AREAS OF PARTICULAR CONCERN
Estuarine Areas	**Area - Wide**
Estuarine Emergent Wetlands	Council-designated Artificial Reef Special Management Zones
Estuarine Scrub / Shrub Mangroves	Hermatypic (reef-forming) Coral Habitat & Reefs
Submerged Aquatic Vegetation (SAV)	Hard Bottoms
Oyster Reefs & Shell Banks	Hoyt Hills
Intertidal Flats	*Sargassum* Habitat
Palustrine Emergent & Forested Wetlands	State-designated Areas of Importance of Managed Species
Aquatic Beds	Submerged Aquatic Vegetation
Estuarine Water Column[2]	
Seagrass	
Creeks	
Mud Bottom	
Marine Areas	**North Carolina**
Live / Hard Bottoms	Big Rock
Coral & Coral Reefs	Bogue Sound
Artificial / Manmade Reefs	Pamlico Sound at Hatteras / Ocracoke Islands
Sargassum	Capes Fear, Lookout, & Hatteras (sandy shoals)
Water Column[2]	New River
	The Ten Fathom Ledge
	The Point

[1]Essential Fish Habitat areas are identified in Fishery Management Plan Amendments for the South Atlantic and Mid-Atlantic Fishery Management Councils. Geographically Defined Habitat Areas of Particular Concern are identified in Fishery Management Plan Amendments affecting the South Atlantic Area. Information in this table was derived from Essential Fish Habitat: A Marine Fish Habitat Conservation Mandate for Federal Agencies. February 1999 (Revised 10/2001) (Appendices 4 and 5).

[2]EFH for species managed under NMFS Billfish and Highly Migratory Species generally falls within the marine and estuarine water column habitats designated by the Fishery Management Councils.

Table 4-5. Categories of EFH and HAPCs Identified in Fishery Management Plan Amendments Affecting the South Atlantic Area [1,2]

E-EGGS L-LARVAL J-JUVENILE A-ADULT N/A-NOT FOUND	Beaufort Inlet	Bogue Sound	Bogue Inlet	Atlantic Ocean South of Cape Hatteras
COASTAL DEMERSALS				
Red Drum	**E L J A**	**E L J A**	**E L J A**	**JA**
Bluefish	**J A**	**J A**	**J A**	**ELJA**
Summer Flounder	**L J A**	**L J A**	**L J A**	**ELJA**
INVERTEBRATES				
Brown Shrimp	**E L J A**	**L J A**	**E L J A**	**ELJA**
Pink Shrimp	**E L J A**	**L J A**	**E L J A**	**ELJA**
White Shrimp	**E L J A**	**L J A**	**E L J A**	**ELJA**
Calico Scallop	**N/A**	**N/A**	**N/A**	**ELJA**
COASTAL PELAGICS				
Dolphinfish	**J A**	**N/A**	**J A**	**ELJA**
Cobia	**L J A**	**J A**	**L J A**	**ELJA**
King Mackerel	**J A**	**J A**	**J A**	**ELJA**
Spanish Mackerel	**L J A**	**L J A**	**L J A**	**ELJA**
HIGHLY MIGRATORY				
Bigeye Tuna	**N/A**	**N/A**	**N/A**	**ELJA**
Bluefin Tuna	**N/A**	**N/A**	**N/A**	**JA**
Skipjack Tuna	**N/A**	**N/A**	**N/A**	**JA**
Yellowfin Tuna	**N/A**	**N/A**	**N/A**	**ELJA**
Swordfish	**N/A**	**N/A**	**N/A**	**ELJA**
Blue Marlin	**N/A**	**N/A**	**N/A**	**ELJA**
White Marlin	**N/A**	**N/A**	**N/A**	**ELJA**
Sailfish	**N/A**	**N/A**	**N/A**	**ELJA**
Little Tunny	**N/A**	**N/A**	**N/A**	**ELJA**
SHARKS				
Spiny Dogfish	J A	N/A	J A	JA
Smooth Dogfish	J A	J	J A	JA
Small Coastal Sharks	J A	J A	J A	JA
Large Coastal Sharks	J A	N/A	J A	JA
Pelagic Sharks	N/A	N/A	N/A	JA
Prohibited/Research Sharks	J A	N/A	J A	JA
SNAPPER/GROUPER				
Black Sea Bass	L J A	L J A	L J A	ELJA
Bank Sea Bass	N/A	N/A	N/A	ELJA
Rock Sea Bass	J	J	J	ELJA
Gag	J A	J	J A	ELJA
Graysby	N/A	N/A	N/A	ELJA

Table 4-6. EFH Species for Coastal North Carolina

E-EGGS L-LARVAL J-JUVENILE A-ADULT N/A-NOT FOUND	Beaufort Inlet	Bogue Sound	Bogue Inlet	Atlantic Ocean South of Cape Hatteras
Speckled Hind	N/A	N/A	N/A	ELJA
Yellowedge Grouper	N/A	N/A	N/A	ELJA
Coney	N/A	N/A	N/A	ELJA
Red Hind	N/A	N/A	N/A	ELJA
Goliath Grouper	N/A	N/A	N/A	ELJA
Red Grouper	N/A	N/A	N/A	ELJA
Misty Grouper	N/A	N/A	N/A	ELJA
Warsaw Grouper	N/A	N/A	N/A	ELJA
Snowy Grouper	N/A	N/A	N/A	ELJA
Yellowmouth Grouper	N/A	N/A	N/A	ELJA
Black Grouper	J	J	J	ELJA
Scamp	N/A	N/A	N/A	ELJA
Blackfin Snapper	N/A	N/A	N/A	ELJA
Red Snapper	N/A	N/A	N/A	ELJA
Cubera Snapper	N/A	N/A	N/A	ELJA
Lane Snapper	N/A	N/A	N/A	ELJA
Silk Snapper	N/A	N/A	N/A	ELJA
Vermillion Snapper	N/A	N/A	N/A	ELJA
Mutton Snapper	N/A	N/A	N/A	ELJA
Gray Snapper	J	J	J	ELJA
Gray Triggerfish	N/A	N/A	N/A	ELJA
Yellow Jack	J	J	J	ELJA
Blue Runner	J	J	J	ELJA
Crevalle Jack	J	J	J	ELJA
Bar Jack	J	J	J	ELJA
Greater Amberjack	N/A	N/A	N/A	ELJA
Almaco Jack	N/A	N/A	N/A	ELJA
Banded Rudderfish	N/A	N/A	N/A	ELJA
Atlantic Spadefish	N/A	N/A	N/A	ELJA
White Grunt	N/A	N/A	N/A	ELJA
Tomtate	N/A	N/A	N/A	ELJA
Hogfish	N/A	N/A	N/A	ELJA
Puddingwife	N/A	N/A	N/A	ELJA
Sheepshead	J A	J A	J A	ELJA
Red Porgy	N/A	N/A	N/A	ELJA
Longspine Porgy	N/A	N/A	N/A	ELJA

Table 4-6 (continued). EFH Species for Coastal North Carolina

E-EGGS L-LARVAL J-JUVENILE A-ADULT N/A-NOT FOUND	Beaufort Inlet	Bogue Sound	Bogue Inlet	Atlantic Ocean South of Cape Hatteras
Scup	N/A	N/A	N/A	ELJA
Blueline Tilefish	N/A	N/A	N/A	ELJA
Sand Tilefish	N/A	N/A	N/A	ELJA
SMALL COASTAL SHARKS			PROHIBITED SHARKS	
Atlantic Sharpnose Shark				Sand Tiger
Finetooth Shark				Bigeye Sand Tiger
Blacknose Shark				Whale Shark
Bonnethead				Basking Shark
LARGE COASTAL SHARKS				White Shark
Silky Shark				Dusky Shark
Tiger Shark				Bignose Shark
Blacktip Shark				Galapagos Shark
Spinner Shark				Night Shark
Bull Shark				Reef Shark
Lemon Shark				Narrowtooth Shark
Nurse Shark				Shark
Scalloped hammerhead				Smalltail Shark
Great Hammerhead				Atlantic Angel Shark
Smooth Hammerhead				Longfin mako
				Bigeye Thresher
PELAGIC SHARKS				Sharpnose Sevengill shark
Shortfin Mako				Bluntnose sixgill Shark
Porbeagle				Bigeye Sixgill Shark
Thresher Shark				
Oceanic Whitetip Shark				
Blue Shark			RESEARCH SHARKS	
				Sandbar Shark

Table 4-6 (continued). EFH Species for Coastal North Carolina

The State of North Carolina defines Primary Nursery Areas (PNAs) as tidal salt waters that provide essential habitat for the early development of commercially important fish and shellfish. It is in these estuarine areas that many fish species undergo initial post-larval development. The North Carolina Marine Fisheries Commission designates PNAs. Neither Morehead City Harbor nor the beaches of Bogue Banks or Shackleford Banks are located within a designated Primary Nursery Area (PNA) (15 NC Administrative Code 3B .1405).

The State of North Carolina, Department of Environment and Natural Resources, Division of Marine Fisheries Artificial Reef Program manages six reefs that are located off Bogue Banks (Figure 4-9). They are Artificial Reefs (AR) 315, AR 320, AR 330, AR 340, AR 342, and AR 345. None are in proximity to the proposed work.

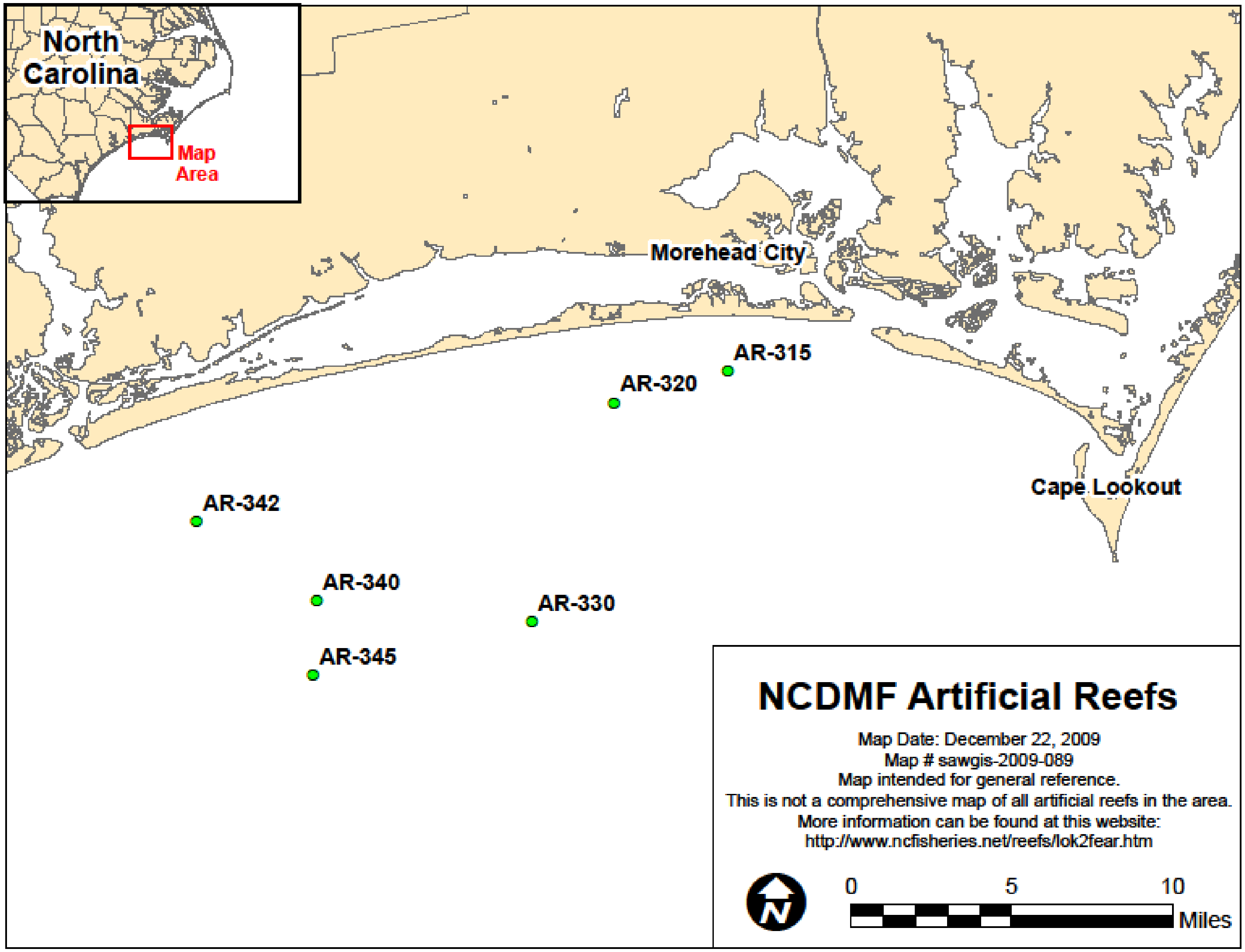


Figure 4-9. Location of NCDMF Artificial Reefs in the Project Area

4.6 Wetlands and Floodplains

Coastal wetlands of the project vicinity include tidal salt marshes, which occur along the shorelines and island fringes along the backside of Bogue and Shackleford Banks. Intertidal wetlands of the area are very important ecologically because of their high primary productivity, their role as nursery areas for larvae and juveniles of many marine species, and their refuge/forage value to wildlife. In addition, they provide aesthetically valuable natural areas. Many types of wetland communities are present in the project area including smooth cordgrass marsh, needlerush marsh, saltmeadows, and high marsh. All are important primary producers of organic matter and, therefore, serve as part of the base of the aquatic food chain. Smooth cordgrass (*Spartina alterniflora*) marshes occur within the intertidal zone along the sounds and tidal creeks and provide valuable nursery habitat for many commercially valuable species of marine and estuarine organisms. The frequent removal of organic material and the daily tidal sedimentation processes make salt marsh communities very productive (Schafale and Weakley 1990). Needlerush marsh is dominated by black needlerush (*Juncus romerianus*) and occurs in areas that are irregularly flooded. Saltmeadows are essentially pure stands of salt meadow cordgrass (*Spartina patens*), which can occur between 3.5–5.0 ft. above mean sea level. Salt grass (*Distichlis spicata*), sea lavender (*Limonium carolinianum*), glasswort (*Salicornia* spp.), and sea ox-eye (*Borrichia frutescens*) are also prominent plants in this community. High marsh is a transitional community between high ground areas and wetlands and, depending on location and frequency of flooding, may have characteristics of either. It is important in stabilizing the shifting sands of the barrier island. Given time and protection, it will eventually become vegetated with dominant shrub species such as marsh elder (*Iva frutescens*), wax myrtle (*Myrica cerifera*), and yaupon (*Ilex vomitoria*) (Wilson 1962).

Section 404 wetlands are those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support a prevalence of vegetation typically adapted for life in saturated soil conditions (33 C.F.R. § 328.3). Wetlands possess three essential characteristics: hydrophytic vegetation, hydric soils, and wetland hydrology. Along the beaches of Bogue Banks, the nearshore placement areas off Bogue and Shackleford Banks, and the ODMDS there are no jurisdictional Section 404 wetlands. There may be wetlands within or adjacent to Brandt Island. Once Brandt Island reaches capacity, if a dike raise or expansion is determined to be feasible, an Environmental Assessment (EA) will be prepared and all appropriate environmental clearances will be obtained.

On NPS-managed lands (i.e., Shackleford Banks): The National Park Service classifies wetlands according to the U.S. Fish and Wildlife Service's "Classification of Wetlands and Deepwater Habitats of the United States" (Report FWS/OBS-79/31); Cowardin et al. 1979). These NPS designated wetlands are also subject to NPS

D.O. #77-1 and its implementation procedures. Under the Cowardin definition, a wetland must have one or more of the following three attributes:

1. at least periodically, the land supports predominantly hydrophytes (wetland vegetation);
2. the substrate is predominantly undrained hydric soil; or
3. the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year.

According to Item 3 above, along the 3.65 mile Shackleford Banks ocean beach disposal area, NPS designated wetlands would be located between the mean higher high water contour (upper limit) and the mean lower low water contour (lower limit). Additionally, during one disposal event only up to 2 miles of the 3.65 mile long disposal area on Shackleford Banks would be used. However, over the twenty years, the entire 3.65 mile long disposal area may be used. The existing NPS designated wetlands along the beach disposal area on Shackleford Banks (following the Cowardin et al. (1979) wetland definition and classification system) are about 25.6 acres in size. These wetlands are discussed in more detail in Section 6.8, Executive Order 11990.

Floodplains. The 100-year flood plain is established by the Federal Emergency Management Agency (FEMA) and is identified on Federal Insurance Rate Maps. Base flood elevations for flood zones and velocity zones are also identified by FEMA, as are designated floodways. All the beach disposal areas on both Bogue and Shackleford Banks are within the 100-year floodplain.

Beach disposal on Bogue and Shackleford Banks is an alteration of the floodplain in that the zone of tidal flooding is displaced seaward. Beach disposal of dredged material on either Bogue and/or Shackleford Banks cannot be accomplished outside the floodplain.

4.7 Terrestrial Resources

The terrestrial resources of Brandt Island, Bogue Banks, and Shackleford Banks include vegetation, wildlife, birds, and mammals and are described below.

4.7.1 Vegetation

When compared to most of North Carolina's upland communities, the beach and dune community in the project area could be considered depauperate in both plants and animals. The environment on the beach is severe because of constant exposure to salt spray, shifting sands, wind, and sterile soils with low water retention capacity. Beach vegetation known from the area includes beach spurge (*Euphorbia polygonifolia*), sea rocket (*Cakile edentula*) and pennywort (*Hydrocotyle bonariensis*). The threatened plant, seabeach amaranth (*Amaranthus pumilis*) occurs sporadically along the dune faces of Bogue Banks and Shackleford Banks. The dunes along Bogue and Shackleford Banks are more heavily vegetated with American beach grass (*Ammophila breviligulata*), panic grass (*Panicum amarum*) sea oats (*Uniola paniculata*), broom straw (*Andropogon virginicus*) and salt meadow hay (*Spartina patens*) being commonly observed.

The low amount of vegetation found on the urban and developed Bogue Banks is primarily due to human presence. In comparison, the relatively low human presence on Shackleford Banks results in a more heavily vegetated shoreline.

The east to west aligned Shackleford Banks extends from Beaufort Inlet on the west to Barden’s Inlet on the east (Figure 4-8). Back Sound and the Atlantic Ocean border Shackleford Banks along the northern and southern boundaries. The upland portion of the barrier island is approximately 2,280 acres (Au 1974). The elevation of the dunes are higher in the western portion of the barrier island near Beaufort Inlet and lower in elevation in the eastern portion near Barden’s Inlet. According to an early 1853 U.S. Coast and Geodetic Survey map, the barrier island was completely covered by forest (Au 1974). Because of anthropogenic influences such as stock grazing (goats, cattle, horses, and sheep), cutting trees for homes and boat building as well as the hurricane of August 1899, the forested areas were either removed or killed (Au 1974). Once the vegetation was removed, successive storms have caused the loose sand to cover the remaining forested areas. According to Au (1974), only 5% of the island is covered by forest. The remaining maritime forest is predominantly vegetated with live oak (*Quercus virginiana*) and red cedar (*Juniperus virginiana*).

Vegetation at Cape Lookout National Seashore forms distinctive ecological zones across the barrier islands as shown in the Figure 4-10, Cross Section of Barrier Island Ecological Zones, below. The zones and some of their dominant plants, according to Snow and Godfrey (1978), which was adapted from Au (1974) are:

<u>Beaches</u>--essentially devoid of vegetation except unicellular algae.

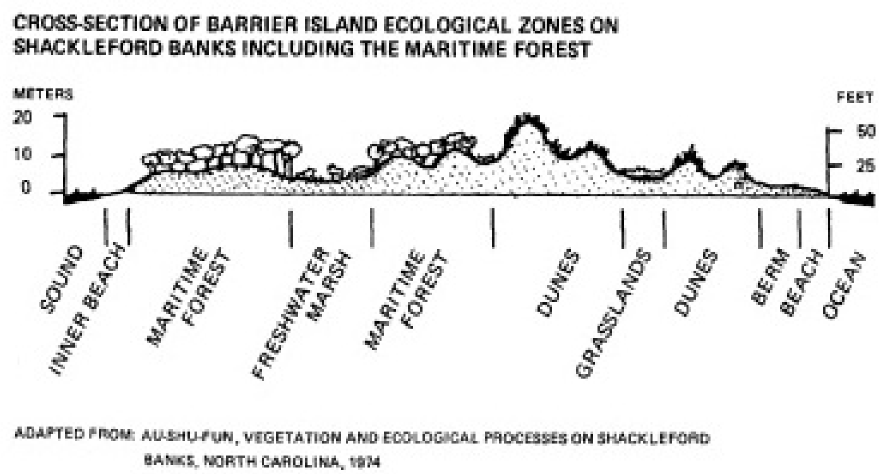


Figure 4-10. Cross Section of Barrier Island Eco-Zones on Shackleford Banks

Berms--created by a few plants such as sea oats growing in the driftline, which may build small dunes, depending on storm frequency.

Tidal Flats--intertidal areas essentially unvegetated except for stands of salt marsh cordgrass; found at inlets.

Dunes--low scattered dunes formed by sea oats in overwash-influenced areas, and high densely vegetated dune fields where vines such as Virginia creeper (*Parthenocissus quinquefolia*) may be found on the back side.

Open Grasslands--sparsely vegetated by salt meadow cordgrass and pennywort, both of which grow up through sand after burial in overwash.

Closed Grasslands--greater cover of pennywort, broom sedge, and hairgrass(*Elocharis acicularis*); Also species of rush (*Elocharis spp.*) where water stands. salt meadow cordgrass, closer to the water table.

Woodlands--shrub thickets of wax myrtle (*Myrica cerifera*), silverling (*Baccharis glomeruliflora*), or of yaupon (*Ilex vomitoria*) and live oak; maritime Virginia red cedar, and American holly (*Ilex opaca*). Both protected lands, marsh elder (*Iva frutescens*), and forests of live oak, are on higher ground.

High Salt Marshes--dominated by black needlerush (*Juncus roemerianus*) and salt meadow cordgrass *(Spartina Patens)*; flooded by spring and storm tides.

Low Salt Marshes--dominated by salt marsh cordgrass *i* flooded at mean high tide .

Subtidal Marine Vegetation--extensive stands of eelgrass (*Zostera spp*.) and widgeon grass (*Ruppia maritima*) in protected, shallow waters.

Because the Shackleford Banks faces the prevailing winds, sand is blown into the dunes, increasing their height and protecting the maritime forest at the western end. Expanses of salt marsh are found to the east of the maritime forest on Shackleford .

From 1943 to 1976, the ocean shoreline of Shackleford Banks eroded approximately 49 feet; an average of 1.5 feet per year (Dolan and Heywood, 1977). Figure 4-11 shows the 1974 vegetation line superimposed on September 2010 aerial photography. It appears that over 36 years (from 1974 to 2010), Shackleford Banks has experienced significant erosion along its shoreline. In some sections of the ocean beach, up to 150 meters (about 500 feet) have been eroded, which translates to an average erosion rate of about 14 feet per year.

Figure 4-11. Shackleford Banks 1974 GIS Vegetation Line (green) Superimposed on 2010 Aerial Photograph

4.7.2 Wildlife

Both Bogue Banks and Shackleford Banks have similar wildlife species and populations residing in the project area. The relatively low human presence on Shackleford Banks results in a greater wildlife population than the urban and developed Bogue Banks. The main exception is the wild horses that are unique to Shackleford Banks.

Mammals. Gray squirrels (*Sciurus carolinensis*) and marsh rabbits (*Sylvilagus palustris*) are abundant on both Bogue and Shackleford Banks. White-tailed deer (*Odocoileus virginianus*) are present, though not in high density. Furbearers that have been observed include raccoon (*Procyon lotor*), mink (*Neovison vison*), muskrat (*Ondatra zibethicus*), otter (*Lontra canadensis*), fox (*Vulpes vulpes*), nutria (*Myocaster coypus*), and opossum (*Didelphis virginiana*). A total of about 32 mammal species are believed to be present on Bogue Banks, Shackleford Banks and Cape Lookout. This list contains 14 species that are primarily carnivorous and 18 rodent species (NPS 1983).

In the herbaceous dune areas on both Bogue and Shackleford Banks, mammals occurring here are opossums, cottontails, raccoons, feral house cats, shrews (*Sorex araneus*), moles (*Talpidae spp.*), voles (*Microtus pennsylvanicus*), and house mice (*Mus musculus*).

The following information is provided by the NPS (Shackleford Banks Horses 2011 Findings Report dated March 30, 2012:

Federal legislation, passed in 1998, protects the wild horses within Cape Lookout National Seashore and requires an annual report on the status of the herd. This report covers the period from April 2011 through March 2012. The National Park Service and the Foundation for Shackleford Horses, Inc. cooperatively manage the horses, pursuant to the legislation and a Memorandum of Understanding updated in 2007.

There are 109 horses on Shackleford Banks. The population is generally managed between 110 and 130 horses but birth rate was lower and mortality higher than average/anticipated/expected.

Six foals were born in 2011 and one was born in January of 2012. Most reproduction and birth occurs during the spring and summer months when nutrients are most readily available, but, as with any bell-shaped curve, there are outliers like the January filly. One 2011 foal died within a week of birth of unknown causes and another was removed at 6 months of age when his dam was unable to proved sufficient nutrients for him to survive in the wild.

Adult mortality was above average with one under five, five in their teens and two in their twenties dying during this period.

Six mares tested pregnant for 2011; if they foal they should do so before the end of June. The pregnancy tests, because of their timing, do not show mares who might foal in July or later. Summer foals are likely.

Reptiles and Amphibians. A total of 93 amphibian and reptile species are believed to be present on both Bogue and Shackleford Banks (NPS 1983). Species observed include southern leopard frog (*Lithobates sphenocephalus*), green tree frog (*Hyla cinerea*), black rat snake (*Pantherophis obsoletus*), eastern cottonmouth (*Agkistrodon piscivorus*), yellow-bellied turtle (*Trachemys scripta scripta*), and snapping turtle (*Chelydra serpentina*). On Bogue and Shackleford Banks the list of species includes 42 amphibian and 51 reptile species. The largest group of amphibians is frogs, which include 18 species, followed by salamander/newts, 14 species; toads, 6 species; and other amphibians, 4 species. The largest group of reptiles is snakes, 31 species, followed by turtles, 11 species; and lizards/skinks, 9 species (NPS 1983).

Birds. The inlet shorelines on both Bogue Banks (including Brandt Island) and Shackleford Banks have consistently supported bird-nesting habitat. American oystercatchers(*Haematopus palliatus*), least terns (*Sterna antillarum*), and Wilson's plovers (*Charadrius wilsonia*) are nesting on bare sandy flats adjacent to the inlet (Personal Communication, 26 November 2008, Sue Cameron, NC Wildlife Resources Commission). Historically, piping plovers (*Charadrius melodus*), common terns (*Sterna hirundo*), willet (*Catoptrophorus semipalmatus*), also have nested in these areas. During Migratory periods, piping plover, Wilson's plover, semipalmated plover (*Charadrius semipalmatus*), red knot (*Calidris canutus*), sandwich tern (*Sterna sandvicensis*, Forster's tern (*Sterna forsteri*), Royal tern (*Sterna maxima*), least tern (*Sternula antillarum*), gull-billed tern (*Sterna nilotica*), common tern (*Sterna hirundo*), black tern (*Chlidonias niger*), Caspian tern (*Sterna caspia*), herons, egrets, marbled godwit (*Limosa fedoa*), laughing gull (*Larus atricilla*) and cormorant (*Phalacrocorax auritus*) are commonly found in and around the inlets. Overwintering bird species include piping plover, brown pelican, cormorants, Foster's tern, Royal tern, dunlin (*Calidris alpine)*, and various gull species (Fussell 1985).

In the herbaceous dune areas, marsh hawks (*Falco cyaneus*), kestrels (*Falco sparverius*), and other birds of prey forage. Other birds occurring in this area are mourning doves (*Zenaida macroura*), tree swallows (*Tachycineta bicolor*), fish crows (*Corvus ossifragus*), starlings (*Sturnus vulgaris*), meadowlarks (*Sturnella magna*), red-winged blackbirds (*Agelaius phoeniceus*), boat tailed grackles (*Quiscalus major*), and savannah sparrows (*Passerculus sandwichensis*) (NPS 1983).

Colonially nesting waterbirds (gulls, terns, and wading birds) are an important part of the project area ecosystem and add a vital element to the overall aesthetic appeal of the area for the many tourists that visit it each year. These species formerly nested primarily on the barrier islands of the region but have had most of these nesting sites usurped by development or recreational activities. With the loss of their traditional nesting areas, these species have retreated to the relatively undisturbed dredged material disposal islands, which border the navigation channels in the area. These islands often offer ideal nesting areas as they are close to food sources, well removed from human activities, and are isolated from mammalian egg and nestling predators (USFWS 2002).

Species of colonial waterbirds which have been documented to nest on the disposal islands in Bogue Sound or inlets of the project area are shown on Table 4-7. Data was taken from the U.S. Fish and Wildlife Service (USFWS) Draft Coordination Act Report, Bogue Banks Shore Protection Study (USFWS 2002). Other species also use the islands for loafing or roosting during migratory periods or the winter months.

Migratory shorebirds may also use the project area for foraging and roosting habitat (Personal Communication, 26 November 2008, Sue Cameron, NC Wildlife Resources Commission).

The inlet spits, sand flats, and point of Cape Lookout National Seashore also provide nesting habitat for several species of Colonial Waterbirds (CWB). The least tern (*Sterna antillarum*), common tern (*Sterna hirundo*), gull-billed tern (*Sterna nilotica*), and black skimmer (*Rynchops niger*) nest here in single species and mixed species colonies. According to the Cape Lookout National Seashore Colonial Waterbird 2009 Summary**,** only one small colony on Shackleford Banks had 4 black skimmer nests and 4 Forester tern nests, but these nests were lost to raccoon predation. The small CWB colony on Shackleford Banks is located near Barden's Inlet.

Colonial Waterbirds
least tern (*Sterna antillarum*)
Forster's tern (*Sterna forsteri*)
common tern (*Sterna hirundo*)
gull-billed tern (*Gelochelidon nilotica*)
black skimmer (*Rynchops niger*)
glossy ibis (*Plegadis falcinellus*)
white ibis (*Eudocimus albus*)
great egret (*Casmerodius albus*)
snowy egret (*Egretta thula*)
cattle egret (*Bubulcus ibis*)
tricolored heron (*Hydranassa tricolor*)
green heron (*Butorides striatus*)
little blue heron (*Egretta caerulea*)
black-crowned night-heron (*Nycticorax nycticorax*)
great blue heron (*Plegadis falcinellus*)

Table 4-7. Colonial Waterbirds Documented to Nest in Project Vicinity (David Allen, NC Wildlife Resources Commission 2010)

4.8 Threatened and Endangered Species (includes State Protected Species)

The Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531–1543), provides a program for the conservation of threatened and endangered (T&E) plants and animals and the habitats in which they are found. In accordance with section 7 (a)(2) of the ESA, the USACE has been in consultation with the USFWS and NMFS since beginning this study to ensure that effects of the proposed project would not jeopardize the continued existence of listed species or result in the destruction or adverse modification of designated critical habitat of such species.

Updated lists of threatened and endangered (T&E) species for the project area were obtained from NMFS (Southeast Regional Office, St. Petersburg, FL) and the USFWS (Field Office, Raleigh, NC). These were combined to develop the composite list shown in Table 4-8, which includes T&E species that could be present in the area based upon their historical occurrence or potential geographic range. However, the actual occurrence of a species in the area depends upon the availability of suitable habitat, the season of the year relative to a species' temperature tolerance, migratory habits, and other factors.

Additionally, Table 4-9 provides a list of all State Protected Species that may occur in the project area. Mr. John Finnegan, Information Systems Manager, North Carolina Natural Heritage Program, Office of Conservation, Planning and Community Affairs, NC Department of Environment and natural Resources provided these listed species found in Table 4-9.

Species Common Names	Scientific Name	Federal Status
Vertebrates		
American alligator	*Alligator mississippiensis*	T(S/A)
Eastern cougar	*Felis concolor couguar*	Endangered*****
North Atlantic Right whale	*Eubaleana glacialis*	Endangered
Blue Whale	*Balaenoptera musculus*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered
Finback whale	*Balaenoptera physalus*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
Green sea turtle	*Chelonia mydas*	Threatened[1]
Hawksbill turtle	*Eretmochelys imbricata*	Endangered
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Loggerhead sea turtle	*Caretta caretta*	Threatened
West Indian Manatee	*Trichechus manatus*	Endangered
Piping Plover	*Charadrius melodus*	Threatened
Red-cockaded woodpecker	*Picoides borealis*	Endangered
Roseate tern	*Sterna dougallii*	Endangered
Red knot	*Calidris canutus rufa*	Proposed Threatened
Smalltooth sawfish	Pristis pectinata	Endangered
Shortnose sturgeon	*Acipenser brevirostrum*	Endangered
Atlantic Sturgeon	*Acipenser oxyrhynchus oxyrhynchus*	Endangered
Invertebrates		
a skipper (butterfly)	*Atrytonopsis sp1*	FSC
Vascular Plants		
Rough-leaved loosestrife	*Lysimachia asperulaefolia*	Endangered
Seabeach amaranth	*Amaranthus pumilus*	Threatened

[1]Green turtles are listed as threatened, except for breeding populations in Florida and on the Pacific Coast of Mexico, which are listed as endangered.

KEY:

Status Definition

Endangered - A taxon "in danger of extinction throughout all or a significant portion of its range."

Threatened - A taxon "likely to become endangered within the foreseeable future throughout all or a significant portion of its range."

FSC – Federal Species of Concern. A species under consideration for listing, for which there is insufficient information to support listing at this time.

T(S/A) - Threatened due to similarity of appearance (e.g., American alligator)--a species that is threatened due to similarity of appearance with other rare species and is listed for its protection. These species are not biologically endangered or threatened and are not subject to Section 7 consultation.

Species with 1 asterisk behind them indicate historic record: * Historic record - the species was last observed in the county more than 50 years ago.

Table 4-8. Threatened and Endangered Species Potentially Present In Carteret County, North Carolina

Name Category	Scientific Name	Common Name	State Status
Vascular Plant	*Amaranthus pumilus*	Seabeach Amaranth	T
	Calopogon multiflorus	Many-flower Grass-pink	E
	Dichanthelium caerulescens	Blue Witch Grass	E
	Lysimachia asperulifolia	Rough-leaf Loosestrife	E
	Myriophyllum laxum	Loose Water-milfoil	T
	Platanthera integra	Yellow Fringeless Orchid	T
	Pyxidanthera brevifolia	Sandhills Pixie-moss	E
	Rhynchospora macra	Southern White Beaksedge	E
	Rhynchospora odorata	Fragrant Beaksedge	E
	Rhynchospora pleiantha	Coastal Beaksedge	T
	Solidago verna	Spring-flowering Goldenrod	T
	Spiranthes longilabris	Giant Spiral Orchid	T
	Stylisma pickeringii var.pickeringii	Pickering's Dawn flower	E
	Utricularia olivacea	Dwarf Bladderwort	T
Vertebrate Animal	*Acipenser brevirostrum*	Shortnose Sturgeon	E
	Alligator mississippiensis	American Alligator	T
	Ammodramus henslowii susurrans	Eastern Henslow's Sparrow	SC
	Caretta caretta	Loggerhead Sea turtle	T
	Charadrius melodus	Piping Plover	T
	Charadrius wilsonia	Wilson's Plover	SC
	Chelonia mydas	Green Sea turtle	T
	Crotalus adamanteus	Eastern Diamondback Rattlesnake	E
	Crotalus horridus	Timber Rattlesnake	SC
	Dermochelys coriacea	Leatherback Sea turtle	E
	Egretta caerulea	Little Blue Heron	SC
	Egretta thula	Snowy Egret	SC
	Egretta tricolor	Tricolored Heron	SC
	Eretmochelys imbricata	Hawksbill Sea turtle	E
	Falco peregrinus	Peregrine Falcon	E
	Gelochelidon nilotica	Gull-billed Tern	T
	Haematopus palliatus	American Oystercatcher	SC
	Haliaeetus leucocephalus	Bald Eagle	T
Vertebrate Animal	*Heterodon simus*	Southern Hognose Snake	SC
	Ixobrychus exilis	Least Bittern	SC
	Lampropeltis getula sticticeps	Outer Banks Kingsnake	SC
	Laterallus jamaicensis	Black Rail	SC
	Lepidochelys kempii	Kemp's Ridley Sea turtle	E

NC Status – Endangered (E); Threatened (T); Special Concern (SC); E, T, and SC status species are given legal protection status by the NC Wildlife Resources Commission.

Table 4-9. List of State Protected Species Potentially Present in Carteret County (NC Natural Heritage Program 2011)

Name Category	Scientific Name	Common Name	State Status
Vertebrate Animal	*Nerodia sipedon williamengelsi*	Carolina Watersnake	SC
	Malaclemys terrapin centrata	Carolina Diamondback Terrapin	SC
	Neotoma floridana floridana	Eastern Woodrat-Coastal Plain population	T
	Ophisaurus mimicus	Mimic Glass Lizard	SC
	Passerina ciris ciris	Eastern Painted Bunting	SC
	Peucaea aestivalis	Bachman's Sparrow	SC
	Picoides borealis	Red-cockaded Woodpecker	E
	Plegadis falcinellus	Glossy Ibis	SC
	Puma concolor couguar	Eastern Cougar	E
	Rana capito	Carolina Gopher Frog	T
	Rynchops niger	Black Skimmer	SC
	Sistrurus miliarius	Pigmy Rattlesnake	SC
	Sterna dougallii	Roseate Tern	E
	Sterna hirundo	Common Tern	SC
	Sternula antillarum	Least Tern	SC
	Trichechus manatus	West Indian Manatee	E

NC Status – Endangered (E); Threatened (T); Special Concern (SC); E, T, and SC status species are given legal protection status by the NC Wildlife Resources Commission.

Table 4-9 (continued). List of State Protected Species Potentially Present in Carteret County (NC Natural Heritage Program 2011)

4.9 Cultural Resources

The following section describes the historical setting of the Beaufort and Morehead City project area; cultural, historic and archaeological resources in the Cape Lookout National Seashore (CALO), and the establishment of the CALO:

Archaeologist generally accept the earliest known human settlement of present-day North Carolina occurred sometime during the Paleo-Indian period (12,000 – 10,000 B.P.); though there is increasing evidence for earlier settlement. Paleo-Indians are presumed to have lived in mobile groups emphasizing hunting of large, migratory game.

Evidence of Paleo-Indians in the Coastal Plain is mostly limited to a small number of surface finds of fluted projectile points (Ward and Davis 1999). While the dearth of evidence suggests the region was sparsely populated, late Pleistocene and early Holocene sea levels were lower than today, and many Paleo-Indian sites are likely miles offshore from the present-day coastline (Lewis 2000; Phelps 1983). Warming trends melted glaciers and produced a rise in sea level to within a few meters of present levels by 9,000 B.P. and reached present sea level ca. 2,000 to 5,000 B.P. (Anderson et al. 1996; Lewis 2000).

The archaeological record of the Archaic period (10,000 – 3,000 B.P.) reflects new technologies and lifestyles as Archaic peoples adapted to climatic and environmental changes and mega-fauna extinctions that occurred during the Paleo-Indian period. Adaptive strategies to the changing environment focused on plant gathering and the hunting of modern game animals. Their tool kit included a variety of triangular, corner-notched, bifurcated, and stemmed projectile points, ground stone tools, adzes, drills, and gravers. Archaic social organization likely continued to center on extended families and bands with possible larger seasonal gatherings.

The Archaic period was an extremely important foundation upon which later, more complex societies would grow during the Woodland period (3,000 B.P. – A.D. 1650). The early Woodland period, in particular, probably inhabited the same riverside locations and followed much the same lifestyle as their Archaic period predecessors. Coastal Archaic and Early Woodland period sites and artifact finds appear to be scattered and significant occupations tend to occur during Middle and Late Woodland periods (Ward and Davis 1999). An increasing reliance on horticulture, semisedentary villages, and pottery-making becomes more widespread during the Early Woodland period (Ward and Davis 1999).

Regional cultures begin to appear in the Late Woodland period as agriculture, large population increase, and more permanent settlements occurred. The project area lies close to the border archaeologists have defined for separating the North Carolina Coastal Plain into north and south cultures based upon ethnohistoric records and linguistic and cultural attributes. The Tidewater zone from present-day Onslow County to Virginia was occupied by Algonkian-speaking tribes, while Siouanspeaking tribes resided south of this area to South Carolina (Phelps 1983; Ward and Davis 1999).

The Colington phase defines the cultural tradition of the Algonkian-speaking tribes in the Late Woodland to European contact. Shell-tempered pottery, ranked societies or chiefdoms, longhouse structures, and mass graves or ossuaries are defining traits of the Colington phase (Phelps 1983; Ward and Davis 1999). The Colington phase ended ca 1650 with the expansion of European colonial settlement from Virginian (Phelps 1983).

Historical Maritime Overview of Beaufort and Morehead City Vicinity.

Among the earliest residents of Shackleford Banks and Cape Lookout during the late 1600s and early 1700s were whalers, who established a series of temporary camps and shelters amid the dunes. By the 1720s, Cape Lookout and Shackleford Banks became a more permanent base of operations for New England whalers (Angley 1982). When Beaufort was appointed as "a port for the unloading and discharging [of] vessels," in 1722 it was clear that successful development would also depend on trade entering and clearing through Beaufort Inlet (Paul 1970; Angley 1982). Unlike many of the inlets along the North Carolina coast, Beaufort Inlet was relatively stable and open and offered a safe and deep channel for ship traffic (Stick 1958)

Although Beaufort remained a relatively unimportant port during the eighteenth century it did play a small role in Revolutionary War maritime activity. While the blockade imposed upon the American coast by the British Navy seriously impacted trade for many Colonial ports, shipping through Beaufort provided a portion of the supplies needed by the Patriots in North Carolina. In the years that followed the Revolution, North Carolina experienced an increase in the volume of maritime trade and shipbuilding. Just after the turn of the century, Beaufort Inlet was described as one of the best on the North Carolina coast, with "the channel being generally 3 1/4 to 3 1/2 fathoms" deep. Beaufort was mentioned as having a fairly vigorous, though small, shipbuilding industry (Tatham 1806). In 1810, Jacob Henry, a former representative from Carteret County to the North Carolina House of Commons, commented upon the local shipbuilding industry at Beaufort:

> The principal trade carried on here is ship building in which they have acquired a very considerable reputation.... Live oak and Cedar are the timbers principally used but the stock is by no means so abundant as it has been. Some of the swiftest sailors and best built Vessels in the United States have been launch'd here, particularly the Ship Minerva, a well known Packet between Charleston and New York. There are at present five Vessels at the Stocks, two of which are ready to be launch'd (Newsome 1929).

The Beaufort vicinity was severely battered by a hurricane that struck the area in 1815. The storm later described as "being one of the most violent and disastrous ever known upon the coast" brought about significant changes to the bar at Beaufort.

The bar was "injured so that but 12 feet could be brought over it at low water." Fortunately the channel eventually recovered from the storm's damage and by 1830 depth on the bar had increased to eighteen feet at mean low water. By 1854 the bar channel had decreasing slightly to a depth of 15 1/2 feet and migrated slightly to the south (United States Congress, Senate Executive Document, No. 78, 33rd Congress, pp. 3-4).

Around 1841 John Motley Morehead, governor of North Carolina, had a vision of establishing a port facility at the eastern terminus of the Atlantic and North Carolina Railroad. A decision was finally reached in 1855 to locate the proposed port and rail facility on Sheppard's Point (Konkle 1922). The editor of the Greensboro *Patriot* described the conditions and natural advantages which he believed would benefit maritime traffic through Beaufort Inlet to the new port facility at Morehead City in September 1858:

> The inlet at Beaufort Harbor is, we understand, about three quarters of a mile wide, extending from the point on the Shackleford banks on the east to the point at Fort Macon on the west. Ships drawing from eighteen to twenty feet can cross the bar with safety. Ships crossing the bar, enter the Harbor near the Shackleford banks, then bear in a westwardly direction toward Fort Macon. From the bar at the inlet, across the Sound to Beaufort, is about three miles, this being about the widest part of the Harbor. The channel is in the form of a half-moon, one horn running eastwardly along the Shackleford banks, called Core Sound, and the other westwardly by Morehead and Carolina cities, which are situated on Bogue Sound. The deepest water is along Newport river, which runs in nearly a north direction between Morehead .city and Beaufort, touching the railroad wharf in the former place. The main channel is about one mile wide, so that the inside of the channel would be some two miles from Beaufort, though vessels drawing from nine to ten feet water can approach the Beaufort wharves at full tide. Running up the channel about three miles from the bar, we come to the railroad wharf at Morehead City, where vessels drawing eighteen feet can approach with ease, and unload and take in lading with the greatest safety (Konkle 1922).

Within six months the rail and port facility at Morehead city was prospering, much to the chagrin of the people of Beaufort. Ships were continually calling at the wharfs and being loaded with cargoes directly from train cars:

> Here a steamer drawing twenty feet of water, and the locomotive weighing twenty or thirty tons, with its whole train, may be alongside each other; and this, too, on each side of the wharf at the same time, while in front other vessels may be loading or discharging cargoes (Konkle 1922).

The development of Morehead City was soon disrupted by the Civil War. On 22 March 1862 Union forces occupied Morehead City. Four days later Union troops crossed the Newport River and took control of Beaufort. Fort Macon also fell into

Union forces under General Ambrose E. Burnside following a fierce one-day siege (Stick 1958). Preceding the final assault on Fort Macon, a Union gunboat and one or two smaller vessels were positioned inside Beaufort Inlet, controlling the approaches and exits to Bogue and Core sounds. On 22 April 1862, several Union vessels anchored near Harker's Island to the east of Beaufort, including the steamer *Alice Price* that served as General Burnside's temporary headquarters. When the fall of Fort Macon was imminent, Confederate forces were forced to burn the bark *Glen* on 25 April to keep it out of Union hands. The following day, Colonel Moses J. White, commander of Fort Macon, surrendered to generals Parks and Burnside on Shackleford Banks (Angley 1982; Stick 1958).

The occupation of Fort Macon and the surrounding vicinity provided Union naval forces with access to a deep-water port and place of rendezvous that was used to support the blockading squadron throughout the remainder of the war. During December of 1864 and January of 1865 fleets under Admiral David Porter, massed at Beaufort Harbor in preparation for their assault on Fort Fisher in Wilmington the last major stronghold of the Confederacy in North Carolina. During, the Civil War at least five Confederate vessels were captured at sea in the Cape Lookout area: the schooners *Edwin, Julia, Revere,* and *Louisa Agnes,* captured in 1861; and the steamer *Banshee,* taken on 21 November 1863 (Angley 1982; Price 1948). One Confederate vessel was totally lost in the vicinity as a result of enemy action. On 9 July 1864 the side-wheel steamer *Pevensey* was chased ashore and blown up on Bogue Banks, approximately nine miles west of Beaufort Inlet (Hill 1975). Not all known shipwrecks near Beaufort were a result of enemy action. On 12 June 1863 while en route from the Delaware Capes to Charleston, the U.S.S. *Lavender* ran aground in heavy seas near Cape Lookout Shoals. The *Lavender* was a screw tug of 173 tons. On 20 July 1865 the 186-ton Union screw steamer *Quinnebaugh* went ashore on Beaufort bar in rough weather after her machinery failed. The *Quinnebaugh* was transporting Union troops, refugees, and civilians north at the time of her loss (Shomette 1973, Berman 1972; Lytle and Holdcamper 1975).

Six years after the Civil War, the federal government began measures to reduce the severity of maritime disasters along the coast by establishing the United States Lifesaving Service. In 1874, seven stations were established along the North Carolina coast. In 1875 a similar station was authorized by congress for Cape Lookout. It was not until ten years later that the station was finally built. Over the following years three other stations would be established on Core Banks, and a facility was also established near Fort Macon, just west of Beaufort Inlet (Angley 1982; Stick 1958).

Menhaden fishing became an important source of income for the Cape Lookout Beaufort area in the years following the Civil War. From 1865 to 1873, the state's first menhaden processing plant was in operation on Harker's Island. By the turn of the century several plants were in operation at Beaufort and at various points on Bogue and Core sounds (Hill 1975).

Growth of Beaufort and Morehead City as ports was slow during the late nineteenth and early twentieth century's. In the 1880s, the federal government began work on the improvement of Beaufort Inlet in the hopes of increasing the amount of maritime trade to the port communities. The depth over the bar in the later 19th century was just over fifteen feet, but was said that "the Harbor entrance was rapidly deteriorating; its width, measured from Fort Macon to Shackleford Point, having increased 500 feet between the years 1864 and 1880" (Stick 1958; Angley 1982). The deterioration of the inlet was steadily increasing, and during 1880 the width of the inlet had increased 900 feet farther. As a means to prevent further erosion, jetties were constructed from both shores into the inlet. Over the next five years, five jetties were constructed on Shackleford Point and another six on Fort Macon Point. By 1889 the deterioration of the inlet caused by the erosion had been brought under control (Angley 1982; Stick, 1958).

Between 1905 and 1907 the channel across Beaufort Inlet bar was dredged to a depth of twenty feet at mean low water. A twenty-foot channel, two hundred feet wide, was also provided inside the inlet to the wharves at Morehead City. A smaller channel, seven feet deep and 100 feet wide, was provided to the wharves along the Beaufort waterfront (Angley 1982). The Army Corps of Engineers submitted several reports between 1907 and 1914 that indicated that both Morehead City and Beaufort were growing centers of maritime trade. The majority of vessels utilizing the two ports were fishing boats and small, shallow-draft cargo vessels (Angley 1982). Beaufort Inlet was described in 1907 as being limited in importance:

The present commerce through the inlet is small, owing in a large measure to the hitherto shallow draft of not generally more than 12 feet at mean low water that could be carried across the bar.

> The present annual commerce of Beaufort, N. C., the principal place on the water adjacent to this Harbor, amounts to about 64,000 tons annually, valued at $3,500,000, of which only about one-fourth to one-fifth passes through the inlet (United States Congress, House Document No. 1454, p.3).

Statistics for 1912 reflect that twelve sailing vessels and thirty-five gasoline powered vessels were registered at Morehead City, for a total of forty-seven vessels weighing 570 net tons. At the rival port of Beaufort for the same year, 175 sailing vessels, 240 gasoline powered vessels, and six barges were register, for a total of 421 vessels with net registered tonnage of 6,005 (Angley 1982; United States Congress, House Documents No.1022:4-11 and No. 1108:6-7). A number of vessels that voyaged along the coast became victims of maritime hazards. Between 1 July 1898 and 30 June 1908, eighty-two vessels were reported lost off the North Carolina coast (United States Congress, House Document No. 315, pp. 5-6).

Several of the shipwrecks had themselves become hazards to navigation along the coast. On 20 and 27 February 1891 notices were carried in the Wilmington *Weekly*

Star that the federal government was in the process of removing wrecks that had become obstacles to other vessels:

> Masters and owners of vessels engaged in the coastwise trade will be glad to know that the commanding Officer of the USS *Yantic* has been ordered to cruise along the coast from Sandy Hook to Charleston, S. C. and to destroy, as far as practicable, all abandoned wrecks which are dangerous to navigation. There are a number of these wrecks on the coast of North Carolina and Virginia.
>
> Off the North Carolina coast the *Yantic* will find the schooner *Dudley Farlin,* twenty-four miles northwest of Bodie Island Light; the schooner *Mollie* J. *Saunders,* seven miles southeast of the same light; the steamer *Glenrath,* south by west of Cape Lookout Light, four or five miles farther in shore, the steamer *Aberlady Bay,* and a sunken wreck eighteen miles east-northeast of Frying Pan Shoal Lightship (Wilmington *Weekly Star,* 20 and 27 February 1891).

In a 1897 Congressional report the hazards found at Cape Lookout to maritime traffic were summarized by the captain of the life-saving station at Cape Lookout:

> I ascertain that, since 1888, 19 schooners, 6 steamships, and 1 bark were disabled or ashore around Cape Lookout that would have been unharmed in all probability, if a safe harbor had been near. Two of these steamships and many of the schooners proved total losses. Unknown wrecks are occasionally discovered on or near the shoals. Nine large vessels have been anchored south of the beach at one time during northeasters. When the wind shifted they had to go to sea. Twenty-two schooners have been seen at one time laying to under the lee of Lookout Shoals during a northeast gale, and 57 vessels have been sighted passing by in one day. The locality is being frequented more and more as seafaring men learn the advantage of it. The great danger at present is being caught in the great bight with a southerly gale (United States Congress, House Document No. 25, p. 5).

To prevent vessels from wrecking near Cape Lookout a lighthouse had been in use, but mariners often complained that the light was difficult to see. To remedy this a lightship was put in place at Cape Lookout Shoals in 1904 and remained in operation until 1933 when it was removed (Holland 1968; Stick 1958). In addition to the lightship, a lens lantern was erected in 1900 on Cape Lookout Bight for a "large number of vessels that seek a lee under Cape Lookout" (Holland 1968).

During World War I Cape Lookout Bay served as a rendezvous and staging area for convoys bound for Europe, while Morehead City was occasionally used as a distribution point. From 1926 to 1938 the federal government made considerable improvements to the use of the Port of Morehead City by increasing the depth of the channel from Beaufort Inlet to thirty feet (Stick 1952). In 1923 the tug *Juno* had sunk in the Beaufort Inlet channel causing considerable difficulty for other vessels to pass. The *Juno* was eventually dynamited to clear the entrance. This earlier event may have been a contributing factor in recognizing the need for channel improvements *(The Evening Dispatch,* 23 July 1923; Berman 1972; *List of Iron and Steel Vessels of the United States, 1904).*

Hostilities in the Cape Lookout vicinity were much more evident during the events of World War II. For example, on one night, 18 March 1942, German submarines sank three tankers in the Cape Lookout area: the *Papoose,* the W. E. *Hutton,* and the E. *M. Clark.* Five days later another tanker, the *Naeco* was sunk in the same vicinity (Stick 1952). As a result of the high number of vessel losses occurred during the early stages of the war, defensive measures were put into place. Coastal communities were systematically blacked out; a more efficient convoy system was devised; and additional planes and patrol vessels were put into service for the Cape Lookout area and North Carolina coast in general (Stick 1952).

In the early 1950s improvements were once again undertaken at Morehead City. A project was nearly completed by the summer of 1954 to widen the thirty foot channel to 300 feet to the terminal facilities, construct a 600 foot turning basin, and dredge a twelve foot channel in Bogue Sound along the city's commercial water front (Angley 1982). By 1954 the main shipping channel to Beaufort had also been dredged to a depth of twelve feet and a width of one hundred feet. The improvements could easily accommodate sports and commercial fishing vessels and pleasure craft, but was inadequate to handle large, deep-draft cargo vessels (Angley 1982). Since the mid-1950s regular maintenance dredging has been undertaken at the channels leading into the Morehead City and Beaufort Harbors. Today Morehead City continues as a major deep-water port with several large vessels arriving yearly. Beaufort, however, has long since been eclipsed by her port rival and has been relegated to be content with being a small historic tourist community and haven for small fishing and pleasure craft.

Cape Lookout National Seashore Cultural, Historic, and Archaeological Resources.

The environment of Cape Lookout National Seashore has deterred man from extensively settling the area, although historically the islands have served as prominent landmarks for mariners and have been busy with maritime activities. Early European sailors knew both the dangerous shoals off Cape Lookout Point and the safe Harbor of Lookout Bight. In later years, the Cape Lookout lighthouse warned of the hazards, and life-saving operations rescued seamen in trouble.

Fishing has always been the dominant vocation of the Outer Bankers. With increased maritime activity, Portsmouth Village became a transshipment point where cargo was unloaded and reloaded when ships passed through the shallow Ocracoke Inlet. Later, Diamond City was established on Shackleford Banks for whaling, but it was abandoned during a period of hurricanes in the late 19th century. Today virtually nothing remains of Diamond City, but a number of structures survive in Portsmouth Village. The village is a unique reminder of past cultural and economic life on the Outer Banks.

The state historic preservation officer of North Carolina and the Advisory Council on Historic Preservation has been consulted about the seashore's cultural resources. The lighthouse complex is listed under state significance in the National Register of Historic Places. In addition to the lighthouse, the 25-acre complex includes the keeper's quarters, coal and wood shed, summer kitchen, and fuel storage building. The lighthouse is owned by the U. S. Coast Guard and the other structures belong to the NPS. The existing lighthouse structure dates from 1859, and its diagonal black and white checker pattern dates from 1873. There had been an earlier tower dating from 1812. Portsmouth *Village* is also entered in the National Register as a 250-acre historic district of state significance. There are 25 structures that are typical of coastal Carolina architecture of the 1820-1930 period, at least 8 cemeteries, and 10 ruins and/or sites of former residences. Earlier periods of the village's history are represented poorly by historic structures or not at all.

CALO has 36-recorded archeological sites. These sites are difficult to monitor and protect due to the changing landscape of the barrier islands (NPS 2007). Shell middens were found on the islands in the past, but most have been washed away by storms (NPS 2007). None of the aboriginal sites currently known to exist within the national seashore were felt to be culturally and scientifically significant enough to justify their nomination to the National Historic Register (NPS 2007).

The majority of the sites exist on the soundside of Shackleford Banks, primarily in the salt marshes; some are located on small, marshy islands adjacent to Shackleford. Little evidence of these sites remains due to advanced stages of erosion and other environmental factors. The sites have become damaged from overwash or are submerged at high tide, and only erosion remnants remain. Severe erosion and movement of the land mass have almost obliterated several sites. Some of the sites are covered with thick vegetation, obscuring portions of the site from view. One site has been affected by past use of the area by sheep and goats, to the extent that "little evidence of the site remains intact, or not" (Ehrenhard 1976). According to park staff, looting and vandalism of cultural resources is not a substantial problem.

Establishment of the Seashore

The Seashore's (CALO) enabling legislation was passed in 1966 through the joint efforts of North Carolina and the National Park Service (Public Law 89-366, 80 Stat. 33 (March 10, 1966), codified at 16 U.S.C Section 459 *et seq*.). This followed studies about protection of the Outer Banks from storm destruction. The state of North Carolina concluded that the expense of rehabilitating and developing the banks as a public seashore exceeded state resources, and that the project should be handled by the federal government. Similarly, concern about the increasing development of

America's few remaining natural seashores had been voiced by the NPS in its Surveys of the Atlantic and Gulf Coasts report (1955).

The secretary of the interior declared the establishment of the seashore once there was enough land to sufficiently administer it (Federal Register, September 10, 1976). The enabling legislation defined the seashore to include lithe outer bank of Carteret County, North Carolina, between Ocracoke Inlet and Beaufort Inlet, plus adjoining marshlands and waters. An administrative site at east Harkers Island was authorized and depicted on the map referenced in the amending legislation (map 623-20,009 dated March 1974). The seashore was to be administered for the general purposes of public outdoor recreation, including conservation of natural features contributing to public enjoyment (PL 89-366).

The 55-mile-long narrow strips of sand comprising Cape Lookout National Seashore are breached today by two inlets. The northeast/southwest-oriented Core Banks is divided by Ophelia Inlet (Personal Communication, August 9, 2012, Dr. Michael Rikard, Resource Management Specialist, Cape Lookout National Seashore) into a 21-mile strip north of the inlet and a 22-mile strip plus the 3-mile spit south of the inlet. Barden Inlet separates the southern end of Core Banks from Shackleford Banks, the latter a 9-mile long island with an east-west orientation. Numerous inlets have opened, migrated, and closed in the past, and others can be expected to do the same into the future.

4.10 Esthetic and Recreational Resources (Including Soundscape)

The total environment of barrier islands, ocean, estuaries, and inlets attract many residents and visitors to the area to enjoy the total esthetic experience created by the sights, sounds, winds and ocean sprays.

On Bogue Banks, two ocean piers (i.e., Oceana and Sheraton Hotel) are located in the project area and are considered important recreational facilities. During fall months, recreational surf fishing is a popular activity on both Bogue and Shackleford Banks. Fort Macon State Park and the North Carolina State Aquarium in Pine Knoll Shores on Bogue Banks as well as CALO, Shackleford Banks provide recreational activities for residents and visitors, including beach combing, fishing, swimming, kayaking and other beach activities.

Shackleford Banks supports one of the best and most unique surfing spots on the east cost of the United States (Personal Communication, Doug Piatkowski, Biologist US Army Corps of Engineers, 4 May 2011). Though it does not break all of the time, when the conditions are right, local and national pro surfers will travel long distances to surf this unique wave. The undeveloped nature of the island makes access difficult; however, on a good day the island can host over 200 surfers, photographers, and spectators. Surfers access the island via private boat or Ferry. Ferries provide transportation for a fee from Beauport, North Carolina to Shackleford Banks and are used frequently by recreational visitors, including surfers. Private boats are anchored in open water along the back side of the island and individuals walk across the dunes to the beach front. There is also access via the National Park service pier. The primary surf spot is located just east of the Beaufort inlet spit and extends about 1 mile east along Shackleford Banks.

The south facing angle of the island provides a perfect set up for a south to southeast swell and northeast winds. Large swell generated via low pressure systems or hurricanes (June through November) from the south to southeast direction will come from deep water and hit the shallow nearshore sand bars creating large plunging waves. A northeast wind direction is offshore on Shackleford Banks and will create clean and "glassy" surface conditions. The steep plunging waves and offshore wind direction create a fast and "barreling" beach break wave which is very unique to North Carolina and, with the right conditions, is one of the best spots on the East Coast.

Scenic Quality of the Cape Lookout National Seashore, NPS.

The scenery on Shackleford Banks has the following attributes:

Expansive Vistas--These occur along the ocean and sound shores, where one can see many miles into the distance.

Isolation--Shackleford Banks is detached from the primarily rural mainland and surrounded by water, but is accessible by boat.

Contrast--The many edges between water and land attract the eye, as does the vertical shaft of the lighthouse contrasting with the surrounding flat surfaces. There are also contrasts of maritime forests with sand dunes, dunes with beaches, and stark ghost trees with living ones.

Motion--Rolling surf waves, blowing sand and grass leaves, and flying or running birds are features that catch the eye.

Intimate-Scale Areas--Hollows among the dunes are areas where one may feel alone with that immediate scene.

Color--The greens and grays of the seashore are not the warm colors to which people respond. Occasional blossoms, colorful flotsam, and sunsets stand out all the more against this background. So does the exciting history of shipwreck and life-saving when imagined in the bleakness of winter.

Variety--Views may be toward the mainland, toward the ocean, along the shore, or across the island, each quite different.

Detail--Beachcombing on the shore, fishing in the surf, hiking between the dunes, and inspecting the historic areas are among the activities that bring visitors into close contact with the environment.

Remoteness--The feeling of remoteness from civilization is great in all parts of the islands except for the western sound shore of Shackleford Banks, where industrial development on the mainland is clearly in view.

Soundscape at Cape Lookout National Seashore

NPS *Management Policies 2006* (4.9) and Director's Order 47 ("Soundscape Preservation and Noise Management") recognize the importance of natural soundscapes as park resources. The natural soundscape is defined as the natural sounds in a park which exist in the absence of any human-produced or associated sounds. The policies and director's order call for the National Park Service to preserve, to the greatest extent possible, the natural soundscapes of parks, to restore degraded soundscapes to natural conditions whenever possible, and to protect natural soundscapes from degradation due to noise. "Noise" is defined as unwanted sound that interferes with an activity or disturbs the person hearing them. All human sound could be considered "noise" when compared to the natural soundscape. This does not, however, imply that all human sounds are inappropriate or unacceptable. The range of acceptable human-caused sounds is variable, and what is acceptable in the vicinity of a visitor center may be unacceptable in a campground or a backcountry area.

The natural soundscape of Cape Lookout National Seashore includes all of the naturally occurring sounds such as calling birds and the surf, as well as the quiet associated with still nights. As with all NPS resources, the opportunity to experience natural soundscapes is part of the visitor experience. The natural soundscape of the national seashore contributes to a positive visitor experience and is a direct or indirect component of why many people visit the park. The ambient sound levels or background noise levels at the seashore are generally louder than in other natural park environments due to the ocean environment. According to the NPS, the background sound produced by surf of the ocean is approximately 65 dBA (decibals, a measure of sound).

4.11 Recreational and Commercial Fishing

Commercial and recreational fishing are important industries along Bogue and Shackleford Banks. In Carteret County there are several major centers of fishing activity, recreational and commercial fishing centers at Morehead City and Beaufort. The project area is heavily used by all fishing interests including; surf and pier fishermen, charter boats, and commercial gill-netters and trawlers. Important commercial species include menhaden, thread herring, croaker, and summer flounder. Total commercial landings utilizing Morehead City and Beaufort during 2008 was about 2.9 million pounds at a commercial value of $6.8 million (Personal

Communication, Ms. Grace Kemp, Biologist, NC Division of Marine Fisheries, December 1, 2010).

The beaches of Bogue Banks are used by off road vehicles (ORVs) and surf fishermen. These two interests constitute the major user groups of the project area and contribute to the local economy. The use of ORVs on Bogue Banks beaches is generally restricted to the months of October-April; however numerous public beach access points are available for foot travel year round. ORVs are generally not allowed for the general public on Shackleford Banks except for contractors working on the island.

The Oceana and Sheraton Hotel piers are located in the Town of Atlantic Beach, which is within the proposed project limits. These ocean piers, private recreational vessels, and charter boats that use the near-shore waters also contribute to the local economy. There are no ocean piers on Shackleford Banks but the NPS maintains a small service access pier on Back Sound. This NPS pier is not open for public fishing or recreational use.

4.12 Socioeconomics

Carteret County is located on the lower coastal plain of eastern North Carolina. The county seat of Beaufort lies 150 miles east of Raleigh and 90 miles north of Wilmington, North Carolina. The principal industries are tourism, construction, services, sport and commercial fisheries. The county is also home to a growing retirement population attracted to the area by a mild climate and beautiful natural surroundings. Tourism is generated by the 65 miles of south-facing beaches, Fort Macon State Park, NC Aquarium, NC Maritime Museum, and Cape Lookout National Seashore. Large numbers of vacation homes, motels, restaurants, and shopping centers have been developed to serve the local, retirement, and tourist populations. Additional economic data on the Morehead City Port is found in Section 3.3.2 of the DMMP.

Base Socioeconomic Conditions. From 2000 to 2010, the population of Carteret County grew at a rate of about 12 % (i.e., 2000 population was 59,404 and 2010 population was 66,469). About 40 % of the residents live in one of the county’s municipalities. With its overwhelming economic emphasis on tourism, retail sales in Carteret County comprise the most important source of jobs and income for the county's economy. In 2007, total crop sales for Carteret County were over 20 million dollars, with corn and soybeans as the leading commodities.

Table 4-10 shows the populations of the beach towns and Carteret County since 2000.

Town/County/State	2000 Population	2010 Population
Atlantic Beach	789	1,495
Pine Knoll Shores	1,524	1,337
Indian Beach	95	112
Morehead City	7,691	8,661
Carteret County	59,404	66,469
North Carolina	8,046,813	9,535,483

Table 4-10. Population Statistics, Carteret County, and North Carolina

Projected Population: Carteret County population projections for 2010 – 2030 are shown in Table 4-11.

County/State	2010 Population	2020 Population	2030 Population
Carteret	66,469	69,157	71,852
North Carolina	9,535,483	10,966,956	12,465,481

Table 4-11. Population Projections, Carteret County, North Carolina
(Source: Office of State Planning, State of North Carolina)

Minority and Low Income Populations (includes Children). In 2010, Carteret County is racially composed of 90.1 % White, 7.4 % Black, 2.5 Hispanic, 0.5 % American Indian, 0.7 % Asian, and 0.1 % Native Hawaiian or Pacific Islander, and about 1.1 % of the population identify with two or more races (US Census 2010). The total racial percent of the population may be greater than 100% because Hispanic may be identified in more than one group.

Any individual with total income less than an amount deemed to be sufficient to purchase basic needs of food, shelter, clothing, and other essential goods and services is classified as poor. The amount of income necessary to purchase these basic needs is the poverty line or threshold and is set by the Office of Management and Budget (US Census 2010). The 2010 poverty line for an individual under 65 years of age is $11,161. The poverty line for a three-person family with one child and two adults is $17,268. For a family with two adults and three children the poverty line is $25,603 (US Census 2010).

Carteret County per capita income for 2010 was $26,501 and the median household income for 2010 was $49,711. In 2010, in North Carolina the per capita income was $35,249 and the median household income was $44,357. In 2010 the poverty rate in Carteret County was around 11.8%, and for children ages 0-17 the poverty rate increases to 18.9%. In 2010 the property rate in North Carolina was 16.2% and for children ages 0 to 17 the poverty rate was 22.5% (US Census 2010).

In Carteret County, persons under 18 years old are about 19.2% of the population or about 12,762. Student enrollment for the 2010-2011 school year is about 8,550 in pre-kindergarten through 12th grade. There are eight elementary, four middle, and three high schools in Carteret County (US Census 2010).

In 2011, Carteret County manages 14 parks and 3 County school ball fields, ranging in size from 1 to 31 acres, located from Sea Level to Cedar Point, totaling approximately 200 acres (Carteret County Parks Department 2011). Carteret General Hospital in Morehead City is the only hospital in Carteret County.

Projected State and Regional Population: The State of North Carolina and the seventeen county region around the Port of Morehead City are both important to the activity of the Port. Much of the activity of the port is related to industries and military facilities in the region. From 2000 to 2010, the State grew at an annual rate of 1.7 percent and the region grew at a rate of 1.2 %. In the 5 year period from 2009 to 2014, the State is projected to continue to grow at a rate 1.7 %, while the region is expected to slow to only 0.1 %. Over the following 15 year period from 2014 to 2029, the State is projected to grow at 1.5 % annually and the Region at a rate of 0.6 %. The Port is an important asset in an area of the State that needs jobs and economic growth.

4.13 Other Significant Resources (Section 122, P.L. 91-611)

Section 122 of P.L. 91-611 identifies other significant resources which must be considered during project development. These resources, and their occurrence in the study area, are described below.

4.13.1 Air, Noise, and Water Pollution

a. Air Quality. the ambient air quality for Carteret County has been determined to be in compliance with the National Ambient Air Quality Standards, and this county is designated as an attainment area (Personal Communication, Brad Newland, Engineer, NC Division of Air Quality, 26 November 2010). Section 4.4 provides additional information on this subject.

b. Noise. Noise is a prominent feature in the study area because of the sound of the breakers and at times, tourists, the Port of Morehead City Harbor and traffic on the beach. The sounds of breakers are tranquil and add to the pleasure experienced by visitors on both Bogue and Shackleford Banks. The relatively low human presence on Shackleford Banks reflects a lower noise level than the urban and developed Bogue Banks. Complaints of municipal residents concerning noise in the downtown area of Morehead City due to the port and urban traffic as well as the towns on Bogue Banks are normal. However, these towns on the mainland and Bogue Banks do not experience a problem to the extent that maximum densities for residential dwellings have been established nor have noise level reduction standards (outdoor to indoor or indoor to outdoor) been established. Other than the Port of Morehead City, no large manufacturing, industrial, or mining-type operations are located in the project area. No major airports or other area establishments or entities are affecting unbearable noise levels on the community (Carteret County 2010). The Town of Morehead City has a Noise Ordinance Code (Code 1973, § 13-37; Ord. No. 1987-03, 4-14-87) that is enforced 24 hours a day (Town of Morehead City 2009).

Any harbor or open-water coastal environment has a number of underwater ambient noise sources such as commercial and recreational vessel traffic, dredges, wharf/dock construction (e.g., pile driving), natural sounds (e.g., storms, biological), and so on. To better assess potential species effects (i.e., disturbance of communication among marine mammals) associated with dredge specific noise from navigation maintenance, deepening, or borrow area dredging operations, Clarke et al. (2002) performed underwater field investigations to characterize sounds emitted by bucket, hydraulic cutterhead, and hopper dredge operations. A summary of results from the study are presented below and are a first step toward developing a dredge sounds database that will encompass a range of dredge plant sizes and operational features:

Cutterhead Suction Dredge
Noise generated by a cutterhead suction dredge is continuous and muted and results from the cutterhead rotating within the bottom sediment and from the pumps used to transport the effluent to the disposal area. The majority of the sound generated was from 70 to 1,000 hertz (Hz) and peaked at 100 to 110 decibel (dB) range. Although attenuation calculations were not completed, reported field observations indicate that the cutterhead suction dredge became almost inaudible at about 500 meters (Clarke et al., 2002).

Hopper Dredge
The noise generated from a hopper dredge is similar to a cutterhead suction dredge except there is no rotating cutterhead. The majority of the noise is generated from the drag arm sliding along the bottom, the pumps filling the hopper, and operation of the ship engine/propeller. Similar to the cutterhead suction dredge, most of the produced sound energy fell within the 70- to 1,000-Hz range; however peak pressure levels were at 120 to 140 dB (Clarke et al., 2002).

Bucket Dredge
Bucket dredges are relatively stationary and produce a repetitive sequence of sounds generated by winches, bucket impact with the substrate, bucket closing, and bucket

emptying. The noise generated from a mechanical dredge entails lowering the open bucket through the water column, closing the bucket after impact on the bottom, lifting the closed bucket up through the water column, and emptying the bucket into an adjacent barge. On the basis of the data collected for this study, which included dredging of coarse sands and gravel, the maximum noise spike occurs when the bucket hits the bottom (120 dB peak amplitude). A reduction of 30 dB re 1 μPa/m occurred between the 150 m and 5,000 m listening stations with faintly audible sounds at 7 km. All other noises from the operation (i.e., winch motor, spuds) were relatively insignificant (Clarke et al., 2002).

c. Water quality. The existing water quality in the project area is relatively good. Section 4.3.01 further discusses this subject.

4.13.2 Man-made and Natural Resources, Esthetic Values, Community Cohesion, and Availability of Public Facilities and Services

Dredging in the Morehead City Harbor navigation channels is not expected to cause significant interference with commercial and recreational boat traffic. The mobility of a hopper dredge will preclude any interference with regular commercial ship traffic as a result of travel to and from the navigation channels. Should a hydraulic pipeline dredge be used, the pipeline from the navigation channels to Brandt Island, the beach disposal areas, or the nearshore placement areas will be submerged until it reaches nearshore waters off Bogue and Shackleford Banks or within the pipeline corridor on Atlantic Beach. The pipeline would be marked to let commercial and recreational boaters know of its presence along the bottom. Work barges and other appurtenances associated with a pipeline dredge operating in open water would be moored so as to minimize interference with boat traffic in the area.

The Oceana and Sheraton piers are located in the Town of Atlantic Beach, which are within the proposed project area. During past beach disposal events, a 100-yard buffer on either side of these ocean piers was maintained so as not to adversely impact these structures.

4.13.3 Hazardous, Toxic, and Radioactive Wastes (HTRW)

No HTRW are found within the project area. HTRW is thoroughly discussed in Section 4.2.

4.14 Employment, Tax, and Property Value

In March 2011, Carteret County had a total labor force of 31,895 of which 29,079 were employed and 31,895 was unemployed. For this same date, in North Carolina the total labor force was 4,478,433 of which 4,043,437 were employed and 434,966 were unemployed. In March 2011, the employment rate in Carteret County was 8.8% and in North Carolina was 9.7% (NC ESC 2011).

Carteret County historically has one of the lowest property tax rates in North Carolina, and the 2010 tax rate of $.23/$100 valuation is the lowest rate of any North Carolina county (CEDC 2011).

The study area is a major resort area in Carteret County. Property values contribute to the tax base. The tax base of the first row of oceanfront properties found in Atlantic Beach, Pine Knoll Shores, Indian Beach (includes Salter Path) and Emerald Isle are 38 %, 47 %, 56 %, and 31 % respectively (Personnel Communication, Ralph Foster, Assistant Carteret County Tax Administrator, December 1, 2009).

4.15 Displacement of People, Businesses, and Farms

No people, homes or businesses will be displaced by the proposed DMMP or No Action plan. There will be no utility relocations. There are no farms in the project area which would be affected by the proposed DMMP or the No Action plan.

4.16 Community and Regional Growth

Communities in the Morehead City Harbor vicinity have been experiencing rapid growth during the last few decades (see detailed discussion in Section 4.13 Socioeconomics, above). This growth is expected to continue with or without the proposed DMMP or No Action plan.

4.17 Wilderness Character

The Shackleford Banks portion of Cape Lookout National Seashore consists of a single barrier island located south-southeast of Beaufort, North Carolina. Virtually all of the emergent land on the island, totaling 2,990 acres, has been proposed for designation as wilderness pursuant to the Wilderness Act of 1964. 16 U.S.C. 1131 et seq. Two additional acres have been proposed for designation as potential wilderness.

Shackleford Banks is nine miles long and oriented east-west. It is the most stabilized part of the Seashore and contains the only area of maritime forest within Seashore boundaries. The island itself is a dune-ridge type barrier island. Most of the dunes are less than 10 feet high, but dunes as high as 35 feet occur in the west part of the island. Historically, Shackleford Banks was the site of the now vanished fishing settlement of Diamond City and possibly a revolutionary war fort, Fort Hancock. Today, remnants of historic cemeteries can still be seen on Shackleford, but for the most part the island is virtually undeveloped and roadless. The only development is a ferry landing site near the west end of the island, together with two small restroom facilities a little less than two miles apart. Motorized craft are allowed to land on the island, but no motorized vehicles can be used on the beach or island interior. Apart from the effects of a small herd of feral horses, ecological systems on the island are substantially free from the effects of modern civilization and natural processes on the island are allowed to function free of human control or manipulation. For visitors to the island, there exist significant opportunities for solitude and primitive and unconfined recreation.

Erosion is occurring along Shackleford Banks in part as a result of dredging and maintenance of the navigation channel through Beaufort Inlet. Information contained in several reports suggests that the navigation channel through Beaufort Inlet has exacerbated the erosion of Shackleford Banks. The loss of an average of 177,500 cy/year of sediment within the offshore profile during maintenance dredging operations results in an eroding shoreline within certain sections of the Seashore. Absent active intervention, Shackleford Banks will continue to erode, due partially to the human impacts of the navigation channel.

4.18 Visitor Use and Experience

Public access to Shackleford Banks is by private boat or passenger ferry. At present, there are two ferry service providers located in Beaufort and one in Morehead City. All ferry service providers are required to apply annually for a NPS-issued commercial use authorization which allows the operator to provide commercial ferry service to the park. Ferry operators primarily provide visitors with access to the west end of Shackleford Banks and will occasionally provide service to the Cape Lookout Lighthouse. In the future, NPS intends to implement a single, long-term concession contract with a ferry operator. The concessioner will operate out of the old Post Office building on Front Street in Beaufort.

Annual ferry ridership out of Beaufort averaged approximately 22,200 between 2007 and 2009. Ferry ridership out of Morehead City typically averages between 200 and 300 passengers per year. These figures exclude tours and multi-destination excursions provided by the ferry operators in these locations. A number of visitors travel to the Shackleford Banks on private boats, including kayaks and canoes.

Private vehicles are not authorized on Shackleford Banks and no vehicle ferry service is available. Visitor use consists of hiking, fishing, wildlife observation, photography, and other non-motorized recreational pursuits appropriate to proposed wilderness. Opportunities for solitude and unconfined recreation exist for persons willing to walk some distance from the ferry landing site on the island.

4.19 Park Operation

Seashore management and operations at Shackleford Banks involves staff from the interpretation, resource management, law enforcement, maintenance, and administrative divisions. Within each of these divisions, both staff time and financial resources partially dictate the level of effort that is devoted to management activities at Shackleford Banks. As a proposed wilderness area, Shackleford Banks naturally receives less active management than other parts of the Seashore. For example, maintenance activities on the island are limited due to the minimal facilities present on an island that is almost all proposed wilderness. On the other hand, resource management and law enforcement staff actively monitor the island to protect the sensitive resources present there.

5 ENVIRONMENTAL CONSEQUENCES OF THE RECOMMENDED PLAN AND THE NO ACTION ALTERNATIVE

The following section discusses and compares the environmental effects of the proposed DMMP and the No Action alternative in the Morehead City Harbor project area. The Morehead City Harbor navigation channels are to be maintained to their authorized depth and width. No expansion (i.e., greater depth or width) of the federal navigation channels is planned at this time. A complete project description is found in Section 3.4.2 Summary of Base Plan.

The affected environment of the project area includes the Brandt Island upland diked disposal area, the beaches of Bogue Banks (i.e., Fort Macon State Park, the Towns of Atlantic Beach and Pine Knoll Shores), Shackleford Banks (i.e., within the Cape Lookout National Park, National Park Service) and the waters adjacent to these areas and is described below.

Table 5-1 summarizes and compares the potential environmental effects of the recommended plan and the No Action alternative:

Resource	Recommended Alternative - Proposed DMMP	No Action Alternative
Sediment and Sand	• Reduce Beaufort Inlet Ebb Tide Delta deflation that is related to maintenance dredging within the federal navigation channels. • Coarse-grained dredged material (≥90% sand) disposal on the beaches and nearshore areas off Shackleford and Bogue Banks within the Inlet Influence area will ameliorate sediment losses from the eastern and western lobes of the ebb tide delta.	• Deflation within the Beaufort Inlet Ebb Tide Delta would continue at current rates, potentially leading to wave induced shoreline impacts along Bogue and Shackleford Banks. • Coarse-grained dredged material (≥90% sand) disposal on the beaches and the existing Nearshore West will only decrease losses within the western lobe of the ebb tide delta and along the eastern end of Bogue Banks. No improvement to the eastern lobe of the ebb tide delta or Shackleford Banks beaches.
Water Quality	• No long-term adverse impacts on the water quality. • Transient and minor increases in turbidity during maintenance dredging and dredged material disposal • Control of turbidity during dewatering of Brandt Island	• No long-term adverse impacts on the water quality. • Transient and minor increases in turbidity during dredging and dredged material disposal • Control of turbidity during dewatering of Brandt Island
Air Quality	• . No adverse effect on air quality	• No adverse effect on air quality
Marine Biota	• Temporary displacement of fish and other biota in the expanded Nearshore West and Nearshore East placement areas (ebb-tide delta). Temporary disturbance of benthic organisms within ODMDS and/or nearshore placement areas. Benthic organisms will recolonize areas following disposal. Localized, short-term, and reversible adverse impacts to intertidal macrofauna (beach infauna). Beach disposal will occur once every three years. Coarse-grained material (≥90% sand) disposed of on beaches will minimize impacts to intertidal macrofauna. • No long-term adverse impacts to marine biota	• Temporary displacement of fish and other biota in the existing Nearshore West placement area (ebb-tide delta). • Localized, short-term, and reversible adverse impacts to intertidal macrofauna (beach infauna). • Temporary disturbance of benthic organisms within ODMDS or Nearshore West. Benthic organisms will recolonize areas following placement. Beach disposal will occur once every three years. Coarse-grained dredged material (≥90% sand) disposed of on beaches will minimize impacts to intertidal macrofauna No long-term adverse impacts to marine biota
Essential Fish Habitat	• Temporary displacement of species during dredging and disposal of dredged material along the beach strand and the nearshore placement areas (ebb-tide delta) • No permanent adverse impacts	• Temporary displacement of species during dredging and disposal of dredged material along the beach strand and existing Nearshore West placement area (ebb-tide delta) • No permanent adverse impacts
Terrestrial Biota	• Potential displacement of species during disposal of dredged material in Brandt Island, on Bogue and Shackleford Banks beaches. • Positive benefit to disposal of coarse-grained material (≥90% sand) on Bogue and Shackleford Banks by reducing long-term erosion	• Potential displacement of species during disposal of dredged material in Brandt Island or on Bogue Banks beaches • Positive benefit to disposal of coarse-grained sediment on Bogue Banks by reducing long-term erosion • Negative impact on Shackleford Banks by not attempting to reduce long-term erosion by placing material there
Cultural Resources	• No adverse impacts to known cultural resources	• No impacts to known cultural resources
Esthetic and Recreational Resources (Bogue Banks) **Cape Lookout National Seashore (NPS)**	• Short-term closure of beach areas on Bogue and Shackleford Banks during beach disposal operations. • Temporary esthetic changes due to pipeline on beach during beach disposal • Long-term improvement to esthetics and recreation due to beach disposal of sand • Temporary impacts to the Shackleford Banks' Wilderness Character, Soundscape, Visitor Use and Experience, during beach disposal operations • Disposal of sediment on Shackleford Banks will reduce long-term erosion. • No long-term adverse impacts to the Shackleford Banks	• Short-term closure of beach areas during beach-fill operations. • Temporary esthetic changes due to pipeline on beach during beach-fill. • If long-term erosion continues at its present rate Shackleford Banks may be adversely impacted.

Table 5-1. Summary of Potential Environmental and Socioeconomic Consequences

Resource	Recommended Alternative - Proposed DMMP	No Action Alternative
Recreational and Commercial Fishing	• Temporary displacement from the vicinity of dredging or beach disposal activities • No permanent adverse impacts	• Temporary displacement from the vicinity of dredging or beach disposal activities • No permanent adverse impacts
Socioeconomic Resources	• Increased sand disposal on the beaches of Bogue Banks may contribute to increased beach real estate values. • Disposal of sand on both Bogue and Shackleford Banks may experience short-term adverse impacts during beach disposal. However both Bogue and Shackleford Banks should experience long-term benefits by reducing anthropogenic effects and increasing benefits to visitor use, experience, and tourism in the area. • No permanent adverse impacts	• Sand disposal would continue to occur only on Bogue Banks. Sand disposal may contribute to increased beach related values, reduce anthropogenic effects, increase benefits to visitor use, experience, and tourism on Bogue Banks. • No permanent adverse impacts
Other Significant Resources (Section 122, P.L. 91-611)	• No HTRW sites are located in the project area. No sediments in the navigation channel contain contaminants above regulatory levels. • Temporary increases in noise related to dredging and beach disposal activities. • No permanent adverse impacts for air and water quality and noise	• No HTRW sites are located in the project area. No sediments in the navigation channel contain contaminants above regulatory levels. • Temporary increases in noise related to dredging and beach disposal activities. • No permanent adverse impacts for air and water quality and noise

Table 5-1 (continued). Summary of Potential Environmental and Socioeconomic Consequences

5.1 Physical Resources

5.1.1 Sediment and Sand

Proposed DMMP. The characteristics of the dredged material dictate where disposal of that material will be permitted. Simply, fine-grained materials (less than 80% sand) would be disposed of in Brandt Island (upland confined disposal area) or in the ODMDS. The Nearshore East and West placement areas could be used for predominantly sandy material (sediments ≥ 80% sand). Benthic sediment analyses of these nearshore placement areas indicated that predominantly sandy material would be acceptable for placement there. Coarse-grained sediments (sediments ≥90% sand) would be disposed of on the beaches of Bogue Banks and Shackleford Banks or in the Nearshore East and West. Some coarse-grained material may be disposed of in the ODMDS when inclement weather hinders hopper dredge placement in the nearshore, however, future dredging contracts may not include the option as long as this practice does not become cost prohibitive to implement.

The placement of dredged material on the ebb tide delta, which is part of the littoral system, is expected to contribute to the stability of the ebb tide delta thus positively affecting the littoral system and the associated features. Disposal of material directly on the beach would contribute to improvement of beach stability for beaches of Bogue and Shackleford Banks. However, any time dredged material is not placed in the ebb tide delta, it may adversely affect the deflating ebb tide delta. An understanding of coastal inlet processes suggests that continued erosion of the ebb tide delta complex is likely to eventually impact the adjacent beaches. The mechanisms of ebb tide delta deflation that would lead to impacts to the adjacent beaches include: (1) increased wave heights and changes to their approach angles as a result of changes in the offshore wave transformation, which would result in increased shoreline erosion and volumetric losses of sand along the beach; and (2) changes in longshore transport rates and flow paths of sediment would also be expected.

To the extent practicable, which may include reasonable use of light-loaded vessels, will be made to retain littoral material dredged from the navigation channels within the inlet complex to minimize this ebb tide delta deflation. A comprehensive monitoring program, as outlined in Appendix F Morehead City Harbor Monitoring Plan, will allow the USACE to assess ongoing operations and provide guidance regarding the need for possible modification of future dredging practices to maximize efficacy of dredged material disposal within the system.

As indicated in Section 4.1, there are no known sediment contaminants in the Morehead City Harbor maintenance material, therefore, no sediments with contaminants above regulatory levels would be placed in any disposal areas found within the project area.

No Action Alternative. Inner Harbor material would be disposed in Brandt Island or the ODMDS.

Outer Harbor coarse-grained dredged material would be disposed on the beaches of Bogue Banks and/or the existing Nearshore West placement area off Bogue Banks. Some coarse-grained material may be disposed in the ODMDS during inclement weather.

Outer Harbor Entrance channel material would be disposed within the ODMDS.

The placement of sand on the ebb-tide delta, which is part of the littoral system, is expected to contribute to the stability only of the western lobe of the ebb-tide delta. Disposal of material directly on the beach would contribute to improvement of beach stability only for the beaches of Bogue Banks.

Impacts of the No Action plan on sediment resources would be the similar as those of the proposed plan, however, impacts would be expected to be somewhat greater as the No Action plan does not include the proposed Nearshore East placement area and/or the beaches of Shackleford Banks, which would help balance placement in the ebb tide delta. Deflation within the Beaufort Inlet Ebb Tide Delta would continue most likely at current rates, potentially leading to wave induced shoreline impacts especially along Bogue and Shackleford Banks. Coarse-grained sand disposal on the beaches and the existing Nearshore West placement area off Bogue Banks within the Inlet Influence area will only decrease losses within the western lobe of the ebb tide delta and along the eastern end of Bogue Banks. No improvement to the eastern lobe of the ebb tide delta or Shackleford Banks beaches will occur. Also, the No Action plan does not include expansion of the nearshore west.

There are no known sediment contaminants in the Morehead City Harbor maintenance material therefore the No Action Plan will not place sediments with contaminants above regulatory levels in any disposal areas found within the project area.

5.1.2 Sediment Characteristics

The information mentioned in this section is summarized from the following sources: USACE 2002b, USACE 2008b, and USACE 2011.

If the dredged material from the Morehead City Harbor is disposed on Shackleford Banks, the disposal would generally take place from about the base of the dune (DB) to the -24 ft depth of the beach profile.

From the sediment analysis and surveys (USACE 2008b, USACE 2002b, and USACE 2011) the following conclusions can be made.

a. Grain size analysis. On Shackleford Banks, the mean grain size of beach sediments from the DB to the mean low water contour and from the trough to the -24 foot depth is 0.532 mm and 0.250 mm respectively. The maintenance sediment from the Morehead City Harbor federal navigation channels had a mean grain size of 0.267 mm. The frequency distributions of Shackleford Banks sediments from the TR to -24 ft portion of the beach were similar to the grain size distributions of the Morehead City Harbor sediments considered for beach disposal. The DB to -24 ft grain size frequency distribution for Shackleford sediments were slightly more negatively skewed (coarser) and flatter (less kurtosis) than the Morehead City Harbor sediment distribution. Shackleford Banks sediments above the bar were typically coarser than Morehead City Outer Harbor sediments and particularly so in the surf zone. The Shackleford Banks dune, dune base, and berm crest (mean grain sizes of 0.306 mm, 0.338 mm, and 0.359 mm respectively) were also coarser than Morehead City Harbor sediments (0.267 mm) but not as different as the beach sediments that included surf zone portions of the beach. The Morehead City Harbor sediments had slightly more slit content (passing #230 sieve) at 3.6% vs. 1.0% from the Shackleford Banks DB to -24 ft sediment. The maintenance sediment from the Morehead City Harbor federal navigation channel has slightly more visual shell content (16.0% vs. 13.9% DB to the -24 foot depth on Shackleford) than the native beach on Shackleford Banks.

On Shackleford Banks, the standard deviation of the native sediment from the base of the dune to the mean low water contour and from the trough to the -24 foot depth is 1.29 phi and 0.88 phi, respectively. The Morehead City Harbor sediments had a standard deviation of 0.84 phi. These differences mean that both sediments are moderately sorted and the Shackleford sediments are less sorted than the Morehead City Outer Harbor sediments.

Sediments used to replace natural beach sand should match the natural beach as closely as possible in order to minimize environmental effects. While the scientific literature agrees with this statement in principle, there is little data available to quantify precisely what similarity (or difference) is ecologically significant. Morehead City Outer Harbor sediments at the time of disposal would be similar in terms of grain size distributions to portions of the Shackleford beach profile (specifically the submarine portions of the beach profile) and finer than other portions (specifically the subaerial portions of the beach). Morehead City Harbor sediments disposed on Shackleford Banks would be mobilized and redistributed under a variety of environmental conditions including winds, waves, longshore currents, offshore currents, and tides. As sand travels from the beach to the dunes, the coarse end of the disposed sediment would likely lag behind, rendering the size curves better sorted and also positively skewed.

Over the long term, the speed and degree of ecological recovery largely depend on the physical characteristics of the beach habitat, mainly determined by (1) sediment quality and quantity, (2) the disposal technique and strategy applied,

(3) the location and the size of disposal and (4) the physical environment prior to placement (Speybroeck, J. et al. 2006).

b. Color analysis. The maintenance sediment from the Morehead City Harbor federal navigation channel is slightly redder in hue (10 YR vs. 2.5 Y), slightly lighter in value (8 vs. 7), and slightly grayer in chroma (1 vs. 2) than the Shackleford Banks native beach.

The majority of the sediment from the federal navigation channel is only one increment higher or lighter than the native Shackleford beach (i.e., 8 vs. 7 on the native beach).

From the Munsell hue, value, and chroma measurements, there does not appear to be a significant difference between the color of the Shackleford native beach and the dredged sediment from the federal navigation channel.

Other Considerations

Two other considerations discussed in the following paragraphs were used to provide additional perspectives regarding the sediment proposed for disposal on Bogue Banks and Shackleford Banks and the sand of the receiving beaches. However, neither of these considerations represent requirements that directly apply to the disposal of dredged material from the Morehead City Harbor federal navigation project .

1. NC Technical Standards. Within the State of North Carolina's Coastal Management Program including !5A NCAC 07H .0312 TECHNICAL STANDARDS FOR BEACH FILL PROJECTS (hereafter the NC Technical Standards). These NC Technical Standards regard placement of sediment along the oceanfront shoreline, referred to as beach fill. Beach fill projects include beach nourishment, dredged material disposal, habitat restoration, storm protection, and erosion control. The NC Technical Standards provide requirements for these projects to be permitted particularly with regard to characterization of sediment on the recipient beach and the sediment being disposed. Within the NC Technical Standards, characterization of the recipient beach is not required for the disposal of sediment directly from and completely confined to a federally or state maintained navigation channel. For this reason, the NC Technical Standards do not specifically apply to the disposal of dredged material from the Morehead City Harbor federal navigation project.

The Shackleford Banks beach was sampled using methods similar to those specified in the NC Technical Standards (07 H.0312 (1)(c) and (d). The Morehead City DMMP sampling of Shackleford included about 14 sediment samples were taken along each of 46 shore-perpendicular transects (from the beach dune to -30 foot elevation) about every 1,000 feet of shoreline on Shackleford Banks from Barden (Transect 00) to Beaufort (Transect 460) Inlets. Five samples were taken above MLW and eight samples were taken below MLW on Shackleford. The NC Technical Standards require a minimum of 5 shore perpendicular transects evenly spaced throughout the entire project area (but spaced no more than 5000 feet apart). The NC Technical Standards require transect to extend from the frontal dune crest seaward to a depth of -20 feet (6.1 meters) or to the shore-perpendicular distance 2,400 ft seaward of mean low water, whichever is in a more landward position. The total number of samples taken landward of MLW shall equal the total number of samples taken seaward of MLW.

Specific grain size analysis categories and composite approaches are required by the NC Technical Standards. These were performed for the Shackleford samples.

The NC Technical Standards indicate that sediment is compatible for use as beach fill if the following five criteria (i.e., a through e, below) are met:

a. Fine-grained (less than 0.0625 mm) sediment is less than 10%,

b. The average percentage of fine-grained (less than 0.0625 mm) sediment is less than 5% of the recipient beach, and

c. The average percentage of calcium carbonate (% shell) does not exceed 15% of the recipient beach.

d. The average percentage by weight of granular sediment (greater than or equal to 2 mm and less equal to 4.76 mm) in a borrow site shall not exceed the average percentage by weight of coarse sand sediment of the recipient beach characterization plus 5%.

e. The average percentage by weight of gravel (greater than or equal to 4.76 mm) in a borrow site shall not exceed the average percentage by weight of gravel sized sediment for the recipient beach characterization plus 5%.

Table 5-2 below summarizes information applicable to the NC Technical Standards and all data found in Table 5-2 is summarized from USACE 2002b, USACE 2008b, and USACE 2011. For all sediment samples on Bogue Banks, Shackleford Banks, and the Morehead City Harbor dredged material the percentage of shell (% visual shell) was visually estimated during the sieving procedure. The following paragraphs describe how the proposed action complies with the NC Technical Standards:

a. and b. The Morehead City Harbor sediments contain less than 10% fines (3.6% passing the #230 sieve (0.063 mm). The Shackleford dune (DN) to -24 ft data composite best matches the frontal dune to -20 ft depth sampling composite described in the NC Technical Standards. This Shackleford composite (recipient beach) contained 1.0% #230 fines. The Harbor sediment is less than 5% of the Shackleford sediment (i.e., 3.6% is less than 6% (1% plus 5% = 6%)).

c. The Morehead City Harbor sediment contains 16.0% visual shell. The Shackleford dune (DN) to -24 ft data composite best matches the frontal dune to -20 ft depth sampling composite described in the NC Technical Standards. This Shackleford composite (recipient beach) contained 13.9% visual shell. The Harbor sediment does not exceed 15% of the recipient beach (i.e., 16.0% is less than 28.9% (13.9% + 15% = 28.9%)).

d. Sediment which is greater (coarser) than or equal to 2 mm and less (finer) than 4.76 mm is the difference between that retained by the # 10 sieve (2.0 mm) and the #4 sieve (4.76 mm). For the Morehead City Harbor sediment the percent passing #4 sieve is 98.1% and passing #10 is 95.4%, a difference of 2.7%. For Shackleford Banks (DN to -24 depth) the percent passing the #4 sieve is 96.6% and passing the #10 sieve is 92.5%, a difference of 4.1%. The Harbor sediment is Less than 5% of the Shackleford sediment (i.e., 2.7% is less than 9.1% (4.1% plus 5% = 9.1%)).

e. The sieve size of gravel (greater than or equal to 4.76 mm) is greater than the #4 sieve. The Morehead City Harbor sediment percent passing the #4 sieve is 98.1 and Shackleford Banks (DN to -24 foot depth) is 96.6. That means that the Harbor sediment is 1.9% (100 - 98.1 = 1.9%). Shackleford Banks is 3.4% (100 - 96.6 = 3.4%). Again the Harbor sediment is LESS THAN 5% of the Shackleford sediment (i.e., 1.9% is less than 8.4% (3.4% plus 5% or 8.4%).

Sediment	No. of Samples	mm	phi	Std Dev phi	% Passing #4 sieve nominal size 4.76 mm	%Passing #10 sieve nominal size -2.00 mm	% Passing #200 sieve nominal size -0.074 mm	% Passing #230 sieve nominal size -0.063 mm	%Visual Shell
Morehead City Outer Harbor Channel Sediments	130	0.267	1.90	0.84	98.1	95.4	3.6	3.6	16.0
Shackleford Banks Data All	647	0.323	1.63	1.10	96.7	92.9	1.9	1.5	12.3
Shackleford Banks Data DN to -24 ft	598	0.339	1.56	1.13	96.6	92.5	1.2	1.0	13.0
Shackleford Banks Data DB to -24 ft	552	0.344	1.54	1.20	96.3	91.9	1.3	1.0	13.9
Shackleford Banks Data DB to MLW	230	0.532	0.91	1.29	94.2	87.1	0.4	0.4	22.2
Shackleford Banks Data TR to -24 ft	322	0.25	2.00	0.88	97.8	95.3	1.9	1.5	8.0
Ft Macon	34	0.213	2.23	0.80	NR	99.0	1.6	NR	10.9
Atlantic Beach	82	0.183	2.45	0.79	NR	98.7	3.4	NR	7.1
Pine Knoll Shores	102	0.188	2.41	0.81	NR	98.4	3.6	NR	8.9
Indian Beach	34	0.205	2.28	0.93	NR	98.2	3.2	NR	10.9
East Emerald Isle	47	0.203	2.30	0.74	NR	98.8	2.6	NR	6.3
West Emerald Isle	67	0.193	2.37	0.68	NR	98.7	2.4	NR	4.9
Bogue Inlet Area	51	0.189	2.40	0.52	NR	98.9	1.9	NR	4.0

Table 5-2. Sediment Data Applicable to the North Carolina Technical Standards. All sediment data taken from USACE 2002b, USACE 2008b, and USACE 2011.

2. Overfill Ratio or Factor. An overfill factor is a tool commonly used to evaluate the compatibility of the sediments and to relate the volume of disposed sediment required for a project to perform similarly or comparably to the native beach sand. Thus, an "overfill" factor of 1.0 indicates direct compatibility (that is, borrow and native sands are identical) and an "overfill" factor of 1.1 indicates that the borrow site material is finer and thus 10 % additional material disposal (coverage) is required to compensate for the incompatibility and expected loss of fine sediments. In other cases, the sediment size is predetermined because the sand is a by-product of an inlet channel maintenance project, and thus the design professional is evaluating only how the beach will respond.

Overfill factors do not specifically apply to the DMMP disposal of dredged material from the Morehead City Harbor federal navigation project on Bogue Banks and Shackleford Banks. A primary feature in the DMMP is disposal of dredged material in an environmentally acceptable manner which returns sand to the beach system instead of constructing a dune or berm with specific performance requirements.

There are a number of methods used to compute the overfill ratios, these include: Dean's (1991) Equilibrium Profile Method (EPM) and Pilarczyk, Van Overeem, and Bakker's (1986) Equilibrium Slope Method (ESM).

Table 5-3 shows the results of the Dean's (1991) EPM and Pilarczyk et al (1986) ESM methods of calculating the overfill ratios for the disposal of Morehead City Harbor sediment on Shackleford Banks. Both EPM and ESM overfill ratios used the sediment data taken from USACE 2008a and USACE 2011. The range of the overfill ratio's are from 1.22 to 1.49. The USACE believes that Dean's (1991) EPM overfill ratio of 1.22 is considered to be the most reliable overfill ration based on previous engineering experience and results. Dean's (1991) EPM includes mathematical terms which take into consideration the fill height, the fill width, the significant wave height along with the native beach, and fill grain size mean and standard deviation.

Overfill Ratio[1]	MEAN (phi)	STD DEV (phi)	EPM[2]	ESM[3]
Morehead City Outer Harbor	1.90	0.84	NA	NA
Shackleford Banks Native Data DN to -24	1.56	1.13	1.22	1.49
[1] Assumed: Berm Height = 6' Berm Width = 150' Significant Wave Height = 6.2'				
[2] Dean's (1991) Equilibrium Method				
[3] Pilarczyk et al. (1986) Equilibrium Slope Method				

Table 5-3. Summary of Overfill ratios Calculated for the Disposal of Sediment on Shackleford Banks. All calculations used sediment data from USACE 2008b and 2011.

Proposed DMMP. The USACE believes that the placement of suitable dredge maintenance sediment from the portions of Range C, Range B, the Cutoff and Range A (to station 105+00) in Morehead City Harbor onto the beaches of Bogue and

Shackleford Banks will not cause an adverse impact. No adverse impacts are anticipated.

No Action Alternative. The continued placement of suitable dredge maintenance sediment from the portions of Range C, Range B, the Cutoff and Range A (to station 110+00) in Morehead City Harbor onto Bogue Banks beach will not cause an adverse impact.

5.1.3 Sediment Composition in the Nearshore Placement Areas

Out of the 96 sites sampled, 21.8 % of the sites contained 10.3 % to 61.0 % silt/clay, and 42.7 % had a low silt/clay content (<2% silt/clay). Areas of high silt/clay content (>10% and <61.0%) were found with one large group of sites occurring principally offshore of Shackleford Banks and several smaller areas offshore of Bogue Banks, in water depths ranging from ~20 to 49 feet. Areas of low silt/clay content (less than <2% silt/clan content) predominantly were found along the ebb tide delta and along the nearshore of Bogue and Shackleford Banks. A grouping of these stations also occurs offshore in ~40 feet of water. Three large groups of medium silt/clay content (>2% and <10% silt/clay content) occurred in the mid to nearshore of Shackleford Banks, offshore of the ebb tide delta, and in the mid to nearshore of Bogue Banks.

Proposed DMMP. The placement of dredged material within the nearshore areas of Beaufort Inlet is an important method of reducing the overall deflation of the ebb tide delta. In 1994, the USACE proposed to place suitable sediment from maintenance dredging of the Morehead City Harbor into a nearshore area off Bogue Banks (USACE 1994a and b). Since that time the USACE has disposed of dredged material in the littoral zone west of the Beaufort Inlet (Figure 3-22).

As a part of the U. S. Army Corps of Engineers (USACE) navigation channel maintenance mission, the USACE has conducted research on nearshore placement of mixed sediments under the Dredging Operations and Environmental Research (DOER) Program at the US Army Engineer Research and Development Center (ERDC). ERDC had investigated how fine and coarse-grained sediments behave together and independently when placed in nearshore as mixed sediment.

Nearshore placement of mixed sediment has applications as a beneficial use approach, as material that traditionally is disposed of offshore in the ODMDS and lost to the littoral zone now would be kept nearby and enhance nearshore profiles and beaches. ERDC indicates that nearshore placement supplements the beach profile by adding material to the littoral zone and beaches.

Although, not included as part of the recommended base plan, an option that may be used from time to time is placement of the predominantly sandy material (i.e., 80% or greater sand) dredged from the Inner Harbor with either a pipeline dredge with a spider barge, bucket and barge and/or direct pipeline placement within the nearshore areas off Bogue Banks and Shackleford Banks (Figures 3-22 and 3-23).

A number of mixed sediment nearshore placement mounds have been constructed in the southeast. The USACE, New Orleans District pumped fine-grained sands and silts from the Mississippi River – Gulf Outlet Navigation Channel to the nearshore of Breton Island to create a nearshore mound about 7 foot high in 15 feet of water that persisted for 2 years (Williams and Mathies 1996).

Beginning in late October 1998, the USACE Mobile District and ERDC about 350,000 cubic yards of mixed sediment with the consistency of "black mayonnaise" outside the entrance to Mobile Bay. The water depth of the placement area ranged from 30 to 33 feet. Data was collected prior to, during and periodically following the dredging and placement operations. The conclusions of this study indicate the following: over time the mound has remained essentially intact with little or no deflation, the coarser grained sediment appears to be moving inshore and the finer grained sediment may be moving offshore (Davis et al. 1999).

In February 2001, the USACE Wilmington District worked with ERDC to construct the Cape Fear mixed sediment mound within the Wilmington Ocean Dredged Material Disposal Site (ODMDS). The Wilmington ODMDS is located more than 3 miles offshore of Baldhead Island and in a water depth of 35 feet. About 220,000 cubic yards of mixed sediment was placed on the mound. A monitoring program was designed to assess when and how the mound moves as well as to determine if the fine sediment is winnowed from the placement area leaving the coarser sands behind. Unpublished results (Davis et al. 2001) from this study indicate that the finer grained sediment moves offshore and the coarser grained sediment either moves inshore and/or remains in the placement area.

Savannah District of the USACE is conducting a multi-year study to evaluate dredged material nearshore placement sites in the Savannah and Brunswick Harbors in Georgia (Smith et al. 2007). Savannah District has received obtained required approvals to place maintenance dredged material in nine nearshore areas off the Brunswick Harbor (these 9 placement sites are about 1,200 meters south of the navigation channel) and began placement in 2000. Several of these nearshore placement sites off Brunswick Harbor have maintenance sediment composed of about 80 % sand and 20 % silt/clay. These nearshore sites were located in depths ranging from 2 to 8 meters. Of course, this dredged material is not considered "beach quality". However, it is widely recognized that disposal of this non-beach quality sediment in offshore placement sites (i.e., the ODMDS) potentially reduces erosion to downdrift beaches (Brunn 1996; Dean and Dalrymple 2002).

Related to the nearshore placement of this mixed sediment in these nearshore placement locations at Brunswick Harbor, the following conclusions were reached by Smith et al (2007): 1) Fine sediments were found to winnow rapidly from the eroded dredged material; 2) Fine sediments were not found to deposit permanently in the inner shelf environment. Numerical modeling by Gailani and Lackey (2007) indicated that silt sized sediment was eroded from the mound crest and transported to deeper waters; and 3)

Sandy sediments were found to transport much shorter distances than the fine-grained sediments and remain in the shallow nearshore area.

Based on these existing studies, the nearshore placement of predominantly sandy material (i.e. 80% or greater sand) from the Inner Harbor within the nearshore areas off Bogue and Shackleford Banks would not result in significant adverse impacts since the existing substrate in these nearshore areas are similar to the maintenance sediment that is proposed for placement in these areas. No significant increase in turbidity is expected since these nearshore sites are located within the surf zone Additionally, no hardbottoms and/or SAVs would be adversely impacted by the placement of sediment in these nearshore areas.

No Action Alternative. The No Action alternative would result in the continued use of the existing and previously approved nearshore placement area off Bogue Banks (USACE 1994 a and b). Currently, suitable maintenance dredged sediment (90% or greater sand) from the portions of Range C, Range B, the Cutoff and Range A (to station 105+00) in Morehead City Harbor is placed off Bogue Banks (Figure 4-1). No significant turbidity impacts have been observed since the placement area is located within the surf zone. Additionally no hardbottoms, benthic resources, and/or any cultural resources have been adversely impacted by the placement of sediment in this area.

5.2 Hazardous and Toxic Materials

Proposed DMMP. The North Carolina State Ports Authority (in NCSPA 2001) reviewed information, published by the United States Environmental Protection Agency (EPA), the North Carolina Department of Environment and Natural Resources (NCDENR), and E Data Resources, Inc. (EDR) (an environmental database search firm). This review was used to determine if any known sites producing, storing, and/or disposing of toxic or hazardous materials have affected or have the potential to affect the Morehead City Harbor project area. The EDR database search (EDR 2010) indicated that no HTRW sites where known hazardous wastes are a concern that would be affected by the proposed DMMP.

The DMMP will not place sediments with contaminants above regulatory levels in any disposal areas found within the project area. Therefore, the DMMP will have no anticipated adverse impacts to HTRW.

No Action Alternative. There are no areas where known hazardous wastes are a concern that would be affected by the No Action Plan.

The No Action Plan will not place sediments with contaminants above regulatory levels in any disposal areas found within the project area.

5.3 Water Resources

5.3.1 Water Quality

Proposed DMMP. Return of effluent from Brandt Island can be controlled such that water released from the diked area has little or no suspended solids. Proper management of releases from Brandt Island will not increase turbidity levels in the area of the spillway pipe outfall above 25 NTUs.

Maintenance dredging in the existing federal navigation channels would involve mechanical disturbance of the bottom substrate and subsequent redeposition of suspended sediment and turbidity generated during dredging. Factors that are known to influence sediment spread and turbidities are grain size, water currents and depths. Monitoring studies done on the impacts of offshore dredging indicate that sediments suspended during offshore are generally localized and rapidly dissipate when dredging ceases (Naqvi and Pullen 1983; Bowen and Marsh 1988; Van Dolah et al. 1992). Some infilling of the federal navigation channels after dredging would be expected from side sloughing of native bottom sediments, which consist of predominately sandy material with a small amount of fine or organic material.

During disposal of coarse-grained sediment (90% or greater) along the beaches of Bogue and Shackleford Banks and predominantly sandy material (i.e., 80% or greater sand in the nearshore areas, there would be elevated turbidity and suspended solids in the immediate area of sand deposition when compared to the existing non-storm conditions of the surf zone (Wilber et al. 2006). Significant increases in turbidity are not expected to occur outside the immediate construction/maintenance area (turbidity increases of 25 nephelometric turbidity units [NTUs]) or less are not considered significant). Turbid waters (increased turbidity relative to background levels but not necessarily above 25 NTUs) would hug the shore and be transported with waves either northeast or southwest depending on wind conditions. Because of the low percentage of silt and clay in the coarse-grained sediment (less than 10% for beach disposal and less than 20% for placement in the nearshore areas), turbidity impacts would not be expected to be greater than the natural increase in turbidity and suspended material that occurs during storm events. Any increases in turbidity in the designated disposal areas for the DMMP would be expected to be temporary and limited to the area surrounding the dredging. Turbidity levels would be expected to return to background levels in the surf zone when dredging ends (Wilber et al. 2006).

On March 19, 2012, the North Carolina Division of Water Quality (NCDWQ) has reissued general 401 certifications that cover beach disposal for Shackleford Banks and Fort Macon State Park, Atlantic Beach, and Pine Knoll Shores (NCDWQ Certificate # 3908), nearshore sediment placement off Bogue and Shackleford Banks (NCDWQ Certificate # 3908), and upland diked disposal activities on Brandt Island (NCDWQ Certificate # 3888). Copies of these general water quality certificates are found in Appendix D. All conditions and requirements of the water quality certifications will be adhered to in the implementation of the proposed DMMP.

Short term and minor increases in turbidity will occur at the ODMDS. Only dredged material evaluated and found acceptable in accordance with the joint USEPA/USACE guidance (USEPA/USACE 1991 and USEPA/USACE 1993) may be disposed of in the ocean. The guidance evaluates the potential for unacceptable effects such as toxicity or bioaccumulation including water column effects. These required tests reduce the possibilities of unacceptable water column and benthic effects caused by dredged material contaminants (principally associated with fine-grained sediments).

No adverse impacts to water quality in the project area are anticipated.

No Action Alternative. Return of effluent from Brandt Island can be controlled such that water released from the diked area has little or no suspended solids. Proper management of releases from Brandt Island will not increase turbidity levels in the area of the spillway pipe outfall above 25 NTUs.

Disposal of the dredged material along the Bogue Banks beaches and the existing Western nearshore area (Ebb Tide Delta), would result in short term and minor increases in turbidity and suspended solids in the nearshore zone. Significant increases in turbidity are not expected to occur outside the immediate construction area (turbidity increases of 25 NTUs or less are not considered significant). Turbid waters (increased turbidity relative to background levels but not necessarily above 25 NTUs) may hug the nearshore and be transported with waves either northeast or southwest depending on wind and current conditions. Turbidity levels are expected to return to background levels in the nearshore zone upon cessation of dredging and placement activities.

On March 19, 2012, the NCDWQ has reissued general 401 certifications that cover beach disposal for Fort Macon State Park and the Town of Atlantic Beach (NCDWQ Certificate # 3908), nearshore sediment placement off Bogue and Shackleford Banks (NCDWQ Certificate # 3908), and upland diked disposal activities on Brandt Island (NCDWQ Certificate # 3888).
Short term and minor increases in turbidity will occur at the ODMDS. Only dredged material evaluated and found acceptable in accordance with the joint USEPA/USACE guidance (USEPA/USACE, 1991 and USEPA/USACE, 1993) may be disposed of in the ocean. The project has been authorized pursuant to Section 103 of the Marine Protection Research and Sanctuaries Act for the transport of the dredged material to the ODMDS. USEPA has concurred that the material is acceptable for ocean disposal.

No adverse impacts to water quality have occurred as a result of maintaining the Morehead City Harbor.

5.3.2 Groundwater

Proposed DMMP. No deepening or widening is being proposed beyond the existing authorized channel dimensions. The DMMP is not anticipated to create any adverse impacts on groundwater within the project area.

No Action Alternative. The No Action alternative maintains the authorized depth and width of the federal navigation channels in the Harbor. No deepening or widening of any federal navigation channels were previously approved. No adverse impacts are anticipated on groundwater within the project area.

5.4 Air Quality

Proposed DMMP. The DMMP is not anticipated to result any adverse effects on the air quality of this attainment area. The project would be in compliance with Section 176 (c) of the CAA, as amended.

Maintenance dredging will occur in roughly the same amount. Temporary increases in exhaust emissions from construction equipment are expected during dredging and dredged material disposal operations. The State of North Carolina does have a State Implementation Plan ("SIP") approved or promulgated under Section 110 of the Clean Air Act, as amended. However, a conformity determination is not required because Carteret County has been designated by the State of North Carolina as an attainment area, and the direct and indirect emissions from the project fall below the prescribed *de minimus* levels (58 Fed. Reg. 93.153(c)(1)) and; therefore, no conformity determination would be required.

No Action Alternative. The No Action alternative would not result in any adverse effect on the air quality in this attainment area and is in compliance with Section 176 (c) of the CAA, as amended.

5. 5 Marine and Estuarine Resources

5.5.1 Nekton

Proposed DMMP. Oceanic nekton are active swimmers, not at the mercy of the currents, and are distributed in the relatively shallow oceanic zone. They are composed of three phyla-chordates, mollusks, and arthropods, with chordates (i.e., fish species) forming the largest portion.

Dredging and the disposal activities within Brandt Island would not result in any adverse impacts to nekton. The effluent being discharged from Brandt Island into the Inner Harbor will not adversely impact biota.

Any entrainment of adult fish, and other motile animals in the vicinity of the federal navigation channels during dredging would be expected to be minor because of their ability to actively avoid the disturbed areas (Assessment of Potential Larval Entrainment Mortality Due to Hydraulic Dredging of Beaufort Inlet, Settle 2002). Fish species are expected to leave the area temporarily during the dredging operations and return when dredging ceases (Pullen and Naqvi 1983). Larvae and early juvenile stages of many species pose a greater concern than adults because their powers of mobility are either absent or poorly developed, leaving them subject to transport by tides and currents. That physical limitation makes them potentially more susceptible to entrainment by an operating hydraulic dredge (refer to Section 5.5.5 Larval Entrainment). Benthic-oriented organisms close to the dredge draghead could be captured by the effects of its suction field and entrained in the flow of dredged sediment and water. As a worst-case, it could be assumed that entrained animals experience 100 % mortality, although some small number might survive. Susceptibility to this effect depends on avoidance reactions of the organism, the efficiency of its swimming ability, its proximity to the draghead, the pumping rate of the dredge, and possibly other factors. Behavioral characteristics of different species in response to factors such as salinity, current, and diurnal phase (daylight versus darkness) are also believed to affect their concentrations in particular locations or strata of the water column. Any benthic oriented organisms present near the ocean bottom (i.e., calico scallops and spiney dogfish (SAFMC-managed species) would be closer to the dredge draghead and, therefore, subject to higher risk of entrainment.

The biological effect of hydraulic entrainment has been a subject of concern for more than three decades, and numerous studies have been conducted nationwide to assess its effect on early life stages of marine resources, including larval oysters (Carriker et al. 1986), post-larval brown shrimp (Van Dolah et al. 1994), striped bass eggs and larvae (Burton et al. 1992), juvenile salmonid fishes (Buell 1992), and Dungeness crabs (Armstrong et al. 1982). The studies indicate that the primary organisms subject to entrainment by hydraulic dredges are bottom-oriented fishes and shellfishes. The significance of entrainment effects depends on the species present; the number of organisms entrained; the relationship of the number entrained to local, regional, and total population numbers; and the natural mortality rate for the various life stages of a species. Assessing the significance of entrainment is difficult, but most studies indicate that the significance of impact is low. Effects of dredging activities on marine mammals and sea turtles are addressed in the biological assessment (Appendix J). Although entrainment of benthic oriented organisms would be expected from the proposed dredging activities, a hydraulic dredge operating in the open ocean would pump such a small amount of water in proportion to the surrounding water volume that any entrainment effects associated with dredging of borrow material for the project are not expected to adversely affect species at the population level. In accordance with T&E species observer requirements for hopper dredging activities (Appendix J), inflow screening, as well as observation of dredged material is required to assure accountability of species entrained by the draghead. As a component of hopper dredge observer requirements, all other biota (i.e., fish, bivalves) captured by the inflow screening are recorded and submitted to the USACE for incorporation into a historic entrainment database.

Once maintenance dredging of the federal navigation channels has been completed any temporary short-term entrainment impacts will end. Hydraulic dredges used to maintain the Morehead City Harbor channels operate predominantly when either the cutterhead or the drag-head is in contact with the bottom substrate. The largest pipeline hydraulic dredge that would operate in Morehead City Harbor is about 30-inches in diameter. Comparing the 30-inch diameter pipe to the average cross section of the Harbor, hydraulic entrainment of nekton is not a significant impact. Therefore, the proposed DMMP is not anticipated to adversely impact nekton in the project area.

No Action Alternative. No adverse impacts are anticipated.

5.5.2 Benthic Resources - Beach and Surf Zone

Proposed DMMP. Beach disposal of dredged material and beach nourishment have very similar impacts on the beach and surf zone of Bogue and Shackleford Banks. Within this section the terms "disposal of dredged material" and "beach nourishment" are used interchangeably.

Beach disposal and/or nourishment of sediment may have negative effects on intertidal macrofauna through direct burial, increased turbidity in the surf zone, or changes in the sand grain size or beach profile. Literature dating back to the early 1970s along the southeast coast indicate that opportunistic infauna species (e.g., *Emerita* and *Donax*) found in the nourished areas are subject to direct mortality from burial; however, recovery often occurs within one year (Hayden and Dolan 1974; Saloman 1984; Van Dolah et al. 1992; Van Dolah et al. 1993; Jutte et al. 1999) especially if compatible material is placed on the beach (Hayden and Dolan, 1974; Reilly and Bellis 1978; Saloman 1984; Nelson 1989; Van Dolah et al. 1992; Van Dolah et al. 1993; Hackney et al. 1996; Jutte, P.C. et al. 1999; Peterson et al. 2000). In North Carolina, post-nourishment studies have documented similar reductions in abundance of coquina clams (*Donax* spp.), mole crabs (*E. talpoida*), and amphipods (*Haustoriid* spp.) immediately following disposal with recovery times persisting between one and three seasons after project construction depending on sediment compatibility (Reilly and Bellis 1983; Peterson et al. 2000a; and Coastal Science Associates, Inc. 2002).

Reilly and Bellis (1978) state, "Beach nourishment virtually destroys existing intertidal macrofauna; however, recovery is rapid once the pumping operation ceases. In most cases, recovery should occur within one or two seasons following the project completion." Similar findings were reached by Van Dolah (1992) in a study of the effects of a beach nourishment project in South Carolina. A study by Dolan et al. (1992) of the effects of beachfill activities on mole crabs at the Pea Island National Wildlife Refuge, Dare County, North Carolina, indicates that while nourishment has a dramatic effect on mole crabs in the area where beachfill is placed, mole crabs returned to the beach areas that were nourished soon after pumping stopped.

While beach disposal and/or nourishment may produce negative effects on intertidal macrofauna, they would be localized in the vicinity of the nourishment operation. Beach nourishment conducted as a component of the proposed action would be expected to move along the beach at a relatively slow rate (i.e., about a mile per month or about 200 ft. per day). Such a rate of progress is slow enough that surf-feeding fishes and shorebirds can move to other areas that are not affected by the nourishment operation. As the dredging operation passes by a section of beach, that area is soon available for recolonization by invertebrates.

In a 1999 Environmental Report on the use of federal offshore sand resources for beach and coastal restoration, the U.S. Department of Interior, Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) (formerly known as the Minerals Management Service (MMS), provided the following assessment of potential effects on beach fauna from beach nourishment.

> *Because benthic organisms living in beach habitats are adapted to living in high energy environments, they are able to quickly recover to original levels following beach nourishment events; sometimes in as little as three months (Van Dolah et al. 1994; Levisen and Van Dolah, 1996). This is again attributed to the fact that intertidal organisms are living in high energy habitats where disturbances are more common. Because of a lower diversity of species compared to other intertidal and shallow subtidal habitats (Hackney et al. 1996), the vast majority of beach habitats are re-colonized by the same species that existed before nourishment (Van Dolah et al. 1992; Nelson 1985; Levisen and Van Dolah 1996; Hackney et al. 1996).*

As a component of their review of the potential effects of beach nourishment on surf zone fishes and invertebrates in the South Atlantic Bight, Hackney et al. (1996) identified nine fish species and five invertebrate species/groups that are important inhabitants of the intertidal and subtidal beach environment. According to their literature review of associated impacts to these species and how best to protect the natural resources associated with beach nourishment, they identified four management questions to address for each nourishment project: (1) project timing, (2) sediment compatibility, (3) nourishment duration, and (4) innovative ways to minimize effects (i.e., staging nourishment events). Those questions were considered during planning efforts associated with the proposed dredging and beach disposal efforts for this project. Dredging and disposal would be accomplished within the previously described dredging windows thus avoiding the peak recruitment periods for surf zone fish (March through September [Hackney et al. 1996]) and invertebrate species (May through September [Hackney et al. 1996; Diaz 1980; Reilly and Bellis 1978]) in North Carolina. This means that any beach disposal would be completed before the onshore recruitment of most surf zone fishes and invertebrate species.

Additionally, the proposed DMMP interval for beach disposal on both Bogue and Shackleford Banks is on average every third year. This means that the frequency of beach disposal provides a two to three year period when sediment is not disposed on the beach. Additionally, the USACE will stagger the beach disposal sites on both Bogue and Shackleford Banks in order to avoid impacting the same section of the ocean strand in consecutive years. Moreover, disposal activities on both Bogue and Shackleford Banks would be at a average rate of approximately 200 feet per day or 4-5,000 feet per month; therefore, un-impacted habitat will be available throughout the disposal operation on these ocean beaches.

Disposal of dredged material that is similar with native sediment characteristics minimizes impacts to benthic invertebrates. During each disposal interval, any loss of intertidal organisms would be temporary, as repopulation would be expected to begin as soon as the renourishment operation ends with recolonization of the beach by organisms from adjacent unaffected areas and offshore.

In summary, temporary effects on intertidal macrofauna in the immediate vicinity of the beach disposal activity would be expected as a result of discharges of dredged material on the beach. While the proposed beach disposal may adversely affect intertidal macrofauna, with the implementation of environmental measures discussed above (i.e., project timing, sediment compatibility/similarity, disposal duration, and disposal location, such effects would be expected to be localized and short-term. Any reduction in the numbers or biomass (or both) of intertidal macrofauna present immediately after beach disposal may have localized limiting effects on surf-feeding fishes and shorebirds because of a reduced food supply. In such instances, those animals may be temporarily displaced to other locations.

No Action Alternative. Dredging and the disposal activities within the upland Brandt Island and the offshore ODMDS will not result in any adverse impacts to intertidal macrofauna.

The No Action alternative impacts to the intertidal macrofauna on the beaches of Bogue Banks and in the surf zone would be the same as mentioned for the proposed DMMP, with one exception. The exception would be that the No Action alternative would not include disposal of material on Shackleford Banks.

For the No Action alternative, the proposed beach disposal may adversely impact intertidal macrofauna; however, these effects will be localized and short-term.

5.5.3 Benthic Resources - Nearshore Ocean

Proposed DMMP. Dredging and disposal activities within Brandt Island would not result in any adverse impacts to benthic resources in the nearshore ocean. The effluent being discharged from Brandt Island into the Inner Harbor will not adversely impact biota.

Benthic organisms within the defined federal navigation channels and the nearshore placement areas off Bogue and Shackleford Banks would be lost. However, these channels have been maintained for many years. Construction of Morehead City Harbor was authorized in 1910 and over the years the channels have been widened and deepened to their present width and depth.

The proposed base plan would use the Nearshore Placement areas off Bogue and Shackleford Banks in years 2 and 3 of the 3-year maintenance cycle. Different portions of the Nearshore Placement Areas would be used during each maintenance cycle so the same areas would not be disturbed in year after year, thus allowing recovery time for the benthos. There would also be a full year recovery period in year 1 of the 3-year cycle when placement in the Nearshore Areas would not occur. The 3-year cycle and the proposed placement methodology would minimize impacts to the benthic habitat within the Nearshore Placement areas.

Disturbance and impacts on the benthic habitat by either placement of sediment or by removing sediment (i.e., federal navigation channels) is similar. Benthic organisms would be lost by either placement activities (smothering) and/or by maintaining the federal navigation channels (removal) from the substrate. Additionally, both disposal and maintenance dredging activities would provide new benthic habitat to recolonize over time. The following studies cited describe monitoring studies for impacts of benthic organisms from excavating burrow areas. However, it can be presumed that the maintenance of existing navigation channels and placement sediment in the nearshore areas as described in the proposed DMMP would have similar benthic recovery rates. The reasons being that the existing benthic communities are removed by the proposed dredging action and that there are adjacent undisturbed areas that provide benthic populations for recolonization.

Within the nearshore placement areas off Bogue and Shackleford Banks, recolonization by opportunistic species would be expected to begin soon after the dredging and placement activity stops. Because of the opportunistic nature of the species that inhabit the soft-bottom benthic habitats, recovery would be expected to occur within 1–2 years. Rapid recovery would be expected from recolonization from the migration of benthic organisms from adjacent undisturbed areas and by larval transport. Monitoring studies of post-dredging effects and recovery rates of borrow areas indicates that most borrow areas usually show significant recovery by benthic organisms approximately 1 to 2 years after dredging (Naqvi and Pullen 1982; Bowen and Marsh, 1988; Johnson and Nelson 1985; Saloman et al. 1982; Van Dolah et al. 1984; and Van Dolah et al. 1992). According to Posey and Alphin (2000), benthic fauna associated with sediment removal from borrow areas off of Carolina Beach recovered quickly with greater inter-annual variability than differences from the effects of direct sediment removal. However, a potential change in species composition, population, and community structure may occur from the initial sediment removal impact and the change in surficial sediment characteristics, resulting in the potential for longer recovery times (2–3 years) (Johnson and Nelson, 1985; Van Dolah et al. 1984). Differences in community structure may occur that may last 2–3 years after initial density and diversity levels recover (Wilber and Stern 1992). Specifically, large, deeper-burrowing infauna can require as long as 3 years to reach pre-disturbance abundance. According to Turbeville and Marsh (1982), long-term effects of a borrow site at Hillsboro Beach, Florida, indicated that species diversity was higher at the borrow site than at the control site.

According to Cahoon et al. (1990 and 1992), primary production in Onslow Bay is characterized as being dominated by benthic microalgae, rather than phytoplankton. Therefore, Onslow Bay food web interactions with demersal zooplankton grazers are significant. The nearshore placement areas within the ebb tide delta are located in depths not exceeding 40-feet and average about 25 feet NGVD. According to Dr. Cahoon (Larry Cahoon, personal communication, June 7, 2011), although a direct short-term dredging impact would occur by placing sediment within the nearshore areas benthic microalgae are very adaptable to disturbance and the effects of the dredging would likely be no more significant than large storm events. The chlorophyll *a* concentrations decrease as depth increases; however, solar irradiance at 40 ft. or less is not a limiting factor, and recruitment of benthic microalgae at the proposed post-placement depths (maximum of ~40 ft and average depth of 25 feet NVGD) would be expected to occur fairly quickly (about 4–6 weeks). Furthermore, dredging with nearshore placement is proposed in the winter months when microalgae biomass is low. Therefore, impacts would occur during periods of low biomass, prior to the start of spring time recruitment (Larry Cahoon, personal communication, June 7, 2011).

As identified in Section 5.5.6, placement of sediment in the nearshore areas would not be expected to have an adverse physical effect on any hard bottom in the area. Surveys have indicated that no hard bottoms are located in or adjacent to the nearshore areas off Bogue and Shackleford Banks (USACE 2009).

Effects on estuarine-dependent organisms are not expected to be significant because placement activities in the nearshore areas and on beaches proposed for disposal would be localized and would not occur in the same location in consecutive years. A study of nearshore borrow areas after dredging offshore of South Carolina revealed no long-term effects on fishery and planktonic organisms, as a result of the dredging (Van Dolah et al. 1992). In a 1999 Environmental Report on the use of federal offshore sand resources for beach and coastal restoration, the MMS provided the following assessment of potential turbidity impacts.

> *The impacts from turbidity on benthic organisms during dredging operations were reviewed in detail by Pequegnat et al. (1978) and Stern and Stickle (1978). Both studies concluded that impacts to the benthic populations of the marine ecosystem from turbidity are local and temporary but not permanent. Similarly, recent studies show that benthic impacts may be limited to the immediate vicinity of dredging operations (e.g., Hitchcock et al. 1998; MMS 1996).*

Therefore no long-term adverse impacts to benthic resources are anticipated in the nearshore placement areas.

No Action Alternative. Dredging and the disposal activities within the upland Brandt Island will not result in any adverse impacts to benthic resources.

Disposal of dredged material on the Bogue Banks beaches, the Nearshore West and the ODMDS areas may affect benthos. Covering of benthos and benthic habitat by discharged sediment represents a temporary resource loss since the discharge site will become a new area of benthic habitat and will be recolonized by benthic organisms. The ecological significance of temporary benthic losses is considered minor since the affected area is very small relative to the amount of benthic habitat present on the ocean bottom, the time span of loss is likely a period of months, and benthic populations in the vicinity are in a state of flux due to the dynamic sediment conditions in the area.

The proposed DMMP implementation will continue to use the EPA designated Morehead City ODMDS in accordance with the Morehead City ODMDS Site Monitoring and Management Plan. Only dredged material evaluated and found acceptable in accordance with the joint USEPA/USACE guidance (USAEPA/USACE 1991 and USEPA/USACE 1993) may be disposed of in the ODMDS.

5.5.4 Surf Zone Fishes

Proposed DMMP. The surf zone is a dynamic environment, and the community structure of organisms that inhabit it (e.g., surf zone fishes and invertebrates) is complex. Representative organisms of both finfish and the invertebrate inhabitants they consume exhibit similar recruitment periods. In North Carolina, the majority of invertebrate species recruit between May and September (Hackney et al. 1996; Diaz, 1980; Reilly and Bellis, 1978), and surf zone fish species recruit from March through September (Hackney et al. 1996). Adherence to the previously described dredging and disposal windows would avoid the peak recruitment and abundance periods for most surf zone fishes and their benthic invertebrate prey source.

The surf zone represents HAPC for some species, including adult bluefish and red drum, which feed extensively in that portion of the ocean. The surf zone is suggested to be an important migratory area for larval/juvenile fish moving in and out of inlets and estuarine nurseries (Hackney et al. 1996). Disposal operations along the beach can result in increased turbidity and mortality of intertidal macrofauna, which serves as food sources for those and other species. Therefore, feeding activities of the species could be interrupted in the immediate area of sand disposal. Those mobile species are expected to temporarily relocate to other areas as the project proceeds along the beach. However, some species like Florida pompano and Gulf kingfish exhibit strong site fidelity during the middle portion (summer) of the nursery period (Ross and Lancaster 2002) and might not avoid secondary effects (turbidity) of disposal. Because the project would avoid impacts to the surf zone during the summer months, it is expected that the project would not affect this period of strong site fidelity. Although a short-term reduction in prey availability could occur in the immediate disposal area, only a small area is affected at a time, and once complete, organisms can recruit into the nourished area. Such a recovery would begin immediately after disposal activity if the material is similar to the native beach (see Benthic Resources—Beach and Surf Zone Section 5.5. 2).

According to Ross and Lancaster (1996) some surf zone fishes exhibit prey switching in relation to prey availability. Therefore, during periods of low prey availability, as a result of short-term impacts to the benthic invertebrate population during beach disposal activities, surf zone fishes may temporarily use alternative food sources. Considering the dynamic nature of the surf zone, such opportunistic behavior of avoidance and prey switching might enable some surf zone fishes to adapt to disturbances such as beach nourishment. A combination of short-term prey switching and temporary relocation capabilities may help mitigate short-term prey reductions during beach disposal operations. Once the placement operation is finished, physical conditions in the impact zone quickly recover and biological recovery soon follows. Surf-feeding fish can then resume their normal activities in the areas. That is supported in Ross and Lancaster's (2002) study in which Florida pompano and Gulf kingfish appeared to remain as long near a recently nourished beach as a beach that was not recently nourished.

Disposal and subsequent turbidity increases may have short-term effects on surf zone fishes and prey availability. However, the opportunistic behavior of the organisms within the dynamic surf zone environment enables them to adapt to short-term disturbances. Because of the adaptive ability of representative organisms in the area and avoiding peak recruitment and abundance time frames by adhering to the dredging and disposal windows, such effects would be expected to be temporary and minor.

No Action Alternative. Dredging and the disposal activities within the upland Brandt Island will not result in any adverse impacts to surf zone fishes. Disposal of dredged material on the Bogue Banks beaches, the Nearshore West and the ODMDS areas may affect surf zone fishes and their feeding habitat. However, the surf zone is a dynamic environment, and the community structure of organisms that inhabit it (e.g., surf zone fishes and invertebrates) is complex. Representative organisms of both finfish and the invertebrate inhabitants they consume exhibit similar recruitment periods. In North Carolina, the majority of invertebrate species recruit between May and September (Hackney et al. 1996; Diaz 1980; Reilly and Bellis 1978), and surf zone fish species recruit from March through September (Hackney et al. 1996). The construction time frames for the No Action alternative is from January 1 to March 31 if a hopper dredge is used and November 16 to April 30 if a pipeline dredge is used. These construction windows would avoid a majority of the peak recruitment and abundance periods of surf zone fishes and their benthic invertebrate prey source.

The existing No Action alternative will continue to use the EPA designated Morehead City ODMDS in accordance with the Morehead City ODMDS Site Monitoring and Management Plan. Only dredged material evaluated and found acceptable in accordance with the joint USEPA/USACE guidance (USAEPA/USACE 1991 and USEPA/USACE 1993) may be disposed of in the ODMDS.

5.5.5 Larval Entrainment

Proposed DMMP. For many marine fishes, spawning grounds are believed to occur on the continental shelf with immigration to estuaries during the juvenile stage through active or passive transport. According to Hettler and Hare (1998), research suggests two bottlenecks that occur for offshore-spawning fishes with estuarine juveniles: the transport of larvae into the nearshore zone and the transport of larvae into the estuary from the nearshore zone. During that immigration period from offshore to inshore environments, the highest concentration of larvae generally occurs in the inlets as the larvae approach the second bottleneck into the estuary. Once through the inlet, the shelter provided by the marsh and creek systems in the sound serve as nursery habitat where young fish undergo rapid growth before returning to the offshore environment.

Those free floating planktonic larvae lack efficient swimming abilities and are, therefore, susceptible to entrainment by an operating hydraulic or hopper dredge as they immigrate from offshore to inshore waters. The majority of the Morehead City Harbor navigation channels are located within or adjacent to Beaufort Inlet. Maintenance dredging of these federal navigation channels would occur in the highest concentration *inlet bottleneck* areas.

Susceptibility to this effect of entrainment is largely dependent on proximity to the cutter-head or drag-head and the pumping rate of the dredge. Those larvae present near the bottom would be closer to the dredge area and would, therefore, be subject to higher risk of entrainment. Assessment of the significance of the entrainment is difficult. Assuming the very small volumes of water pumped by dredges relative to the total amount of water in the dredging vicinity, a small proportion of organisms are presumed to be affected. Potential reasons for low levels of impact include the extremely large numbers of larvae produced by most estuarine-dependent species and the extremely high natural mortality rate for early life stages of many fish species. Because natural larval mortalities might approach 99 % (Dew and Hecht 1994; Cushing 1988), entrainment by a hydraulic dredge would not be expected to pose a significant additional risk in most circumstances.

An assessment of potential entrainment effects of the proposed dredging action may be viewed in a more site-specific context by comparing the pumping rate of a dredge with the amount of water present in the affected waterbody (Appendix I). For the purposes of this assessment, assumptions would be made that inlet bottlenecks would have the highest concentrations of larvae as they are transported into the estuarine environment from the nearshore zone. Larval effects of dredging in this *high-concentration* system would be significantly greater than the entrainment risk of dredging in offshore channels. The larval fish distributions, abundance seasonality, transport, and ingress at Beaufort Inlet, North Carolina, has been extensively studied (Blanton et al. 1999; Churchill et al. 1999; Hettler and Barker 1993; Hettler and Chester 1990; Hettler and Hare 1998).

Therefore, it represents a good case study site for assessing larval entrainment of a hydraulic dredge. The largest hydraulic dredge likely to work in offshore borrow areas would have a discharge pipe about 30 inches in diameter and would be capable of transporting about 30,600 m^3 of sand per day if operated 24 hours (because of breakdown, weather, and the like, dredges generally do not work 24 hours a day, 7 days a week). The dredged sediment would be pumped as slurry containing about 15 % sand and about 85 % water by volume. The volume of water discharged would, thus, be about 173,000 m^3 per day, or about 2.0 m^3 per second. In contrast, the calculated spring tide flow through Beaufort Inlet (a representative North Carolina inlet) is approximately 142,000,000 $m^3 \times 2$ = 284,000,000 m^3 (i.e., two tides a day) of water and 264,000,000 m^3 during neap tide. Thus, the dredge would entrain only 0.06 to 0.07 % of the daily volume flux through the inlet. According to Larry Settle (2002), the percentage of the daily flux of larvae entrained during a spring and neap tide is very low regardless of larval concentration and the distribution of larvae within the channel. Under the worst-case scenario with the highest concentrations of larvae possible based on spatial and temporal distribution patterns, the maximum percentage entrained barely exceeds 0.1 % per day. See Appendix I for a complete detailed analysis. Although any larvae entrained (calculations indicate 914 to 1.8 million depending on the initial concentration in the tidal prism) would likely be killed, the effect at the population level would be expected to be insignificant. On the basis of those calculations indicating an *insignificant* larval entrainment impact, at the population level, from hydraulic dredging activities within a representative high concentration *inlet bottleneck* at Beaufort Inlet, North Carolina, the proposed DMMP would not be expected to adversely affect marine fish larvae.

No Action Alternative. The No Action alternative would use the same dredge plants and current windows for maintaining the existing federal navigation channels. The purpose of these dredges (i.e., hopper, pipeline, and bucket and barge) is to remove sediment shoals from the bottom and sides of the existing channels not to pump water from the water column. Larvae and early juvenile stages of many species pose a greater concern that adults because their powers of mobility are either absent or poorly developed, leaving them subject to transport by tides and currents. This physical limitation makes them potentially more susceptible to entrainment by an operating pipeline and/or hopper dredges. Organisms close to the pipeline cutterhead or the hopper dredge draghead may be captured by the effects of its suction and may be entrained in the flow of dredged sediment and water. As a worst-case, it is assumed that entrained animals experience 100 % mortality, although some small number may survive. Due to the large numbers of larval organisms (Appendix I), it is not expected that entrainment mortality would adversely affect species population levels. No adverse impacts are anticipated.

5.5.6 Hardbottoms

Proposed DMMP. Review of data provided by the Southeast Monitoring and Assessment Program (SEAMAP 2001) identified two potential areas of hard bottom one off Pine Knoll Shores, about 2 miles south of the project area and the other off Shackleford Banks, over 2,000 feet off the proposed disposal area (Figure 5-1).

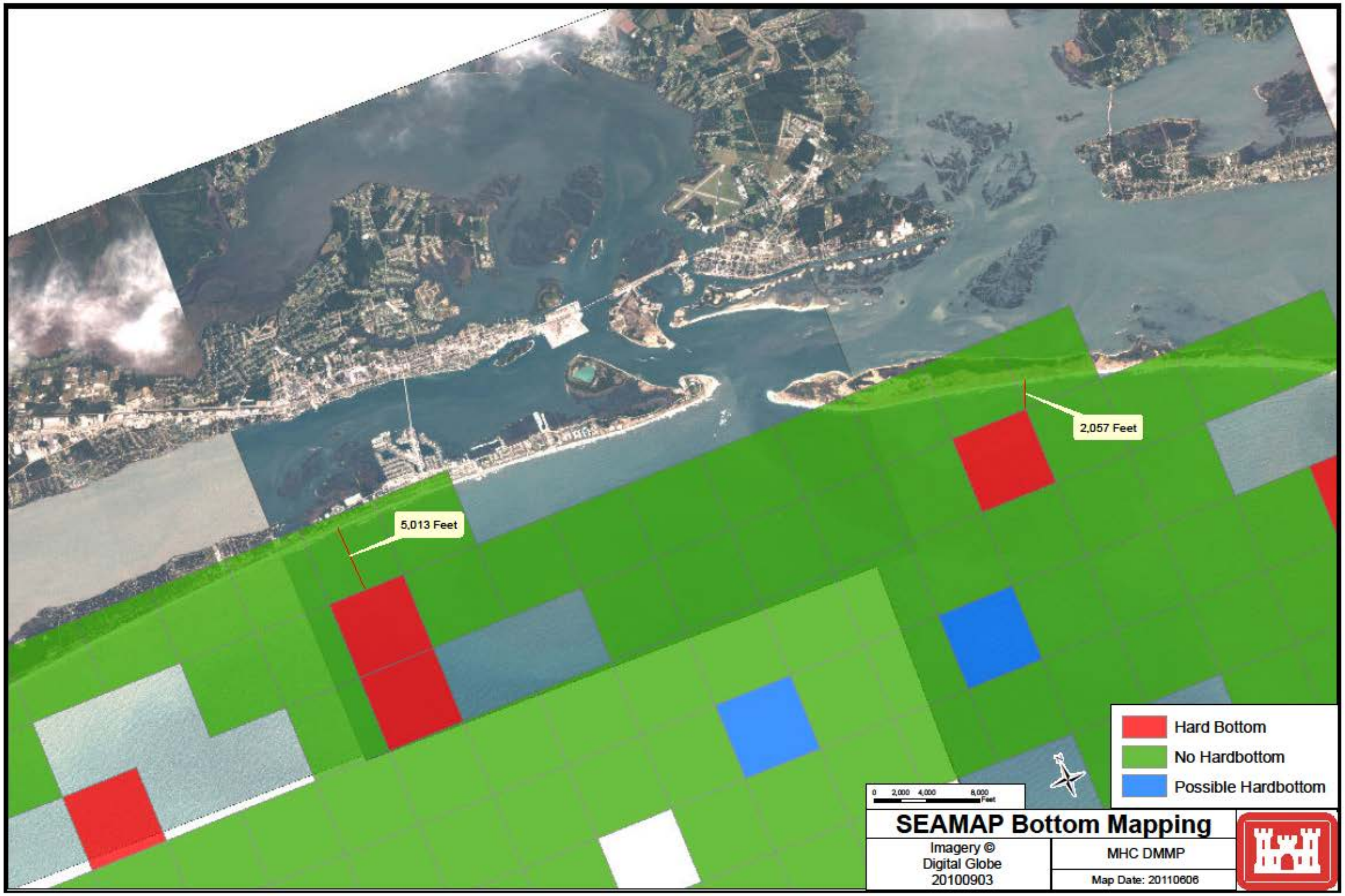


Figure 5-1. Distribution of Potential Bottom Habitats on the Continental Shelf from NC to the Florida Keys (SEAMAP 2001).

Dr. Eleanor J. Camann (2005) indicated that nearshore surveys were conducted along Shackleford Banks using sidescan sonar, swath bathymetry, and Compressed High Intensity Radar Pulse (CHIRP) on November 18, 2003 courtesy of Dr. Jesse McNinch, his equipment, and a Virginia Institute of Marine Science (VIMS) research vessel and crew. The results of these surveys did not find any hardbottom areas offshore off Shackleford Banks (Camann 2005). Discussions with Dr. McNinch (Jesse McNinch, personal communication, 7 June 2011) indicate that the nearshore surveys most likely depicted relict channels where former tidal inlets on the island existed and not hardbottom areas.

To assess potential beach nourishment impacts from the BBHSDR Project to hardbottom resources in the nearshore environment off of Bogue Banks, North Carolina, the U.S. Army Corps of Engineers initiated ground-truthing investigations of potential hardbottom habitat within and adjacent to the project area (USACE 2010a). The study area was located in the nearshore environment off Bogue Banks, North Carolina, between Bogue Inlet and Beaufort Inlet. Previously conducted sidescan sonar surveys of this area and interpretation of that data conducted identified possible seafloor morphology of interest between 250 feet and 2500 feet from shore and between the -5 to -30-foot NGVD water depth contours (Greenhorne and O’Mara 2007). This area is located on and/or within the limits of the calculated -25-foot NVGD depth of closure identified for the BBHSDR and may be impacted as a result of project construction. To assess potential beach nourishment impacts to hardbottom resources, USACE required ground-truth investigations of potential hardbottom within and adjacent to the BBSPP.

Ground-truth verification was completed on January 21 and 22, 2009 (USACE 2009b). Several ground-truthing surveys conducted during the course of this investigation inshore of the depth of closure found only fine sand where sidescan sonar interpretations suggested other seafloor morphologies of interest. The explanation for this discrepancy is that sand movement within the depth of closure along a beach profile is well established and can be proven to have occurred through an examination of historic beach profiles. Although it is logical to assume sand movement inside the depth of closure, which is documented, it is the conclusion of this investigation that no hardbottom resources are present within the area surveyed in 2007 (Greenhorne and O’Mara 2007). This conclusion is based on four primary factors:

(1) A re-analysis and interpretation of sidescan sonar data concluded that no signatures indicative of hardbottom habitats existed in the survey area.

(2) Ground-truthing operations confirmed sidescan sonar interpretation of seafloor morphologies of interest,

(3) No hardbottom was found during ground-truthing operations.

(4) An analysis of historic beach profiles along Bogue Banks (Moffat and Nichol 2008) does not suggest any rock outcrops along beach profiles.

Additional side-scan sonar surveys within the proposed Shackleford Banks nearshore and the proposed expanded Nearshore West placement areas revealed no evidence of hard bottoms. (USACE 2010a). This remote-sensing data confirms that proposed material placement at the sites will not have any impact on exposed hard bottoms or associated marine life.

No Action Alternative. The No Action alternative results in the disposal of suitable sediment on the beaches and nearshore area off Bogue Banks. All maintenance dredging will be located within the existing channels of Morehead City Harbor. There are no hardbottoms within these areas. Review of data provided by the Southeast Monitoring and Assessment Program (SEAMAP 2001) identified one area of hardbottom off Pine Knoll Shores, about 2 miles south of the project area. While beach disposal will cause turbidity, this effect should be minor and temporary and not affect the hardbottom 2 miles off Pine Knoll Shores. The use of the nearshore placement area or the ODMDS will not adversely affect known hardbottom areas.

5.5.7 Essential Fish Habitat

The Fishery Management Plan Amendments of the South Atlantic Fishery Management Council identify over 30 categories of Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC), which are listed in Table 5-4. While all of these habitat categories occur in waters of the southeastern United States, only a few occur in the immediate project vicinity and/or the project impact zone. Those absent include estuarine scrub/shrub mangroves which require a more tropical environment and several areas that are geographically removed from the project area including: Hoyt Hills located in the Blake Plateau area in water 450-600 meters deep, the Point located off Cape Hatteras near the 200-meter contour, and sandy shoals off Cape Hatteras and Cape Fear. In addition, there are no Council-designated Artificial Reef Special Management Zones, Estuarine Emergent Wetlands, Palustrine Emergent & Forested Wetlands, Intertidal Flats, Oyster Reefs & Shell Banks, Aquatic Beds, Wetlands, Creeks, Seagrass Beds, or Submerged Aquatic Vegetation in the potential project impact area, although some of these habitat types may occur in the vicinity of Morehead City, particularly in and around Bogue Sound. Impacts on habitat categories potentially present in the project vicinity are discussed below.

ESSENTIAL FISH HABITAT	Potential Presence		Potential Impacts	
Estuarine Areas	**In / Near Project Vicinity**	**Project Impact Area**	**Dredge Plant Operation**	**Sediment Disposal Activities**
Estuarine Emergent Wetlands	yes	yes	no	no
Estuarine Scrub / Shrub Mangroves	no	no	no	no
Submerged Aquatic Vegetation (SAV)	yes	yes	no	no
Oyster Reefs & Shell Banks	yes	no	no	no
Intertidal Flats	yes	no	no	no
Palustrine Emergent & Forested Wetlands	no	no	no	no
Aquatic Beds	yes	yes	no	no
Estuarine Water Column	yes	yes	insignificant	insignificant
Seagrass	yes	yes	no	no
Creeks	yes	no	no	no
Mud Bottom	yes	no	no	no
Marine Areas				
Live / Hard Bottoms	nearshore ocean	no	no	no
Coral & Coral Reefs	distant offshore	no	no	no
Artificial / Manmade Reefs	>2 mile away	no	no	no
Sargassum	distant offshore	no	no	no
Water Column	yes	yes	insignificant	insignificant
GEOGRAPHICALLY DEFINED HABITAT AREAS OF PARTICULAR CONCERN				
Area - Wide				
Council-designated Artificial Reef Special Management Zones	no	no	no	no
Hermatypic (reef-forming) Coral Habitat & Reefs	distant offshore	no	no	no
Hard Bottoms	nearshore ocean	no	no	no
Hoyt Hills	distant offshore	no	no	no
Sargassum Habitat	distant offshore	no	no	no
State-designated Areas of Importance of Managed Species (PNAs)	yes	yes	no	no
Submerged Aquatic Vegetation (SAV)	yes	yes	no	no
North Carolina				
Big Rock	distant offshore	no	no	no
Bogue Sound	yes	yes	insignificant	insignificant
Pamlico Sound at Hatteras / Ocracoke Islands	yes	yes	no	no
Cape Fear sandy shoals	distant offshore	no	no	no
Cape Hatteras sandy shoals	distant offshore	no	no	no
Cape Lookout sandy shoals	distant offshore	no	no	no
New River	yes	yes	no	no
The Ten Fathom Ledge	distant offshore	no	no	no
The Point	distant offshore	no	no	no

Essential Fish Habitat areas are identified in Fishery Management Plan Amendments for the South Atlantic and Mid-Atlantic Fishery Management Councils. Geographically Defined Habitat Areas of Particular Concern are identified in Fishery Management Plan Amendments affecting the South Atlantic Area. Areas listed in this table were derived from Essential Fish Habitat: A Marine Fish Habitat Conservation Mandate for Federal Agencies. February 1999 (Revised 10/2001) (Appendices 4 and 5).

Table 5-4. Categories of EFH and Habitat Areas of Particular Concern in the Project Vicinity and Potential Impacts

Proposed DMMP. Disposal of sediment within the upland Brandt Island will not adversely impact EFH species.

Sediment disposed on the beaches of Bogue and Shackleford Banks, in the proposed Nearshore East, in the expanded Nearshore West, and within the ODMDS may affect EFH. The following information describes these effects:

Impacts on Big Rock and Ten-Fathom Ledge located off Cape Lookout. This site is located about 18 miles east of the project area and would not be affected by the proposed action.

Impacts to New River. The New River is located about 30 miles from the proposed project and would not be affected.

Impacts on Bogue Sound. All work will be located within the existing Morehead City Harbor navigational channels, Brandt Island, and the Bogue and Shackleford Banks beaches. No dredging or dredged material disposal will occur in Bogue Sound. Therefore the proposed action will not affect Bogue Sound.

Impacts on Sargassum. *Sargassum* is pelagic brown alga which occurs in large floating mats on the continental shelf, in the Sargasso Sea, and in the Gulf Stream. It is a major source of productivity in a nutrient-poor part of the ocean. Masses of *Sargassum* provide extremely valuable habitat for a diverse assemblage of animal life, including juvenile sea turtles, sea birds, and over 100 species of fish. Unregulated commercial harvest of *Sargassum* for fertilizer and livestock feed has prompted concerns over the potential loss of this important resource. While smaller clumps of this seaweed may float into the project area, it typically occurs much farther offshore. In any case, since it occurs in the upper few feet of the water column, it is not subject to impacts from dredging or placement activities associated with the proposed action.

Impacts on Reef-forming Corals. Hermatypic, or reef-forming, corals consist of anemone-like polyps occurring in colonies united by calcium encrustations. Reef-forming corals are characterized by the presence of symbiotic, unicellular algae called zooxanthellae, which impart a greenish or brown color. Since these corals derive a very large percentage of their energy from these algae, they require strong sunlight and are, therefore, generally found in depths of less than 150 feet. They require warm water temperatures (68° to 82° F) and generally occur between 30°N and 30°S latitudes. Off the east coast of the United States, this northern limit roughly coincides with northern Florida. Although they occur off the North Carolina coast, they are not known from the immediate project vicinity, and they should not be affected by the proposed action.

Impacts on Artificial Reefs. The North Carolina Division of Marine Fisheries (NCDMF) lists six artificial reefs (AR) in the project vicinity. They are AR 315, AR 320, AR 330, AR 340, AR 342, and AR 345 (Figure 4-9, above). Dredging and disposal of material on Bogue and Shackleford Banks beaches or in the nearshore placement areas will not be done in close proximity to any of these artificial reefs, so no adverse impacts would occur. The closest artificial reef (AR 315) is about 2 miles offshore off Atlantic Beach in an average water depth of 49 feet. Turbidity plumes may be produced by disposal of the dredged material on the beaches of Bogue and Shackleford Banks or in the nearshore areas as fine sediments are washed away by littoral processes. If such plumes are still detectable as far offshore as the NC Artificial Reef Project (NCARP) reefs, their effects should be minor, temporary, and should quickly dissipate. The proposed action will not significantly impact any NCARP reefs.

Impacts on Hard bottoms. All maintenance dredging will be located within the existing channels of Morehead City Harbor. There are no hard bottoms within these areas. Review of data provided by the Southeast Monitoring and Assessment Program (SEAMAP 2001) identified one area of hard bottom off Pine Knoll Shores, about 2 miles south of the project area. While beach disposal will cause turbidity, this effect should be minor and temporary and not affect the hard bottom 2 miles off Pine Knoll Shores. On 24 August 2009, a contract was awarded to survey the nearshore areas off Bogue and Shackleford Banks for hard bottoms. The results of this survey indicate that no hard bottoms are found within the sediment placement areas in the nearshore areas off Bogue (USACE 2009b) and Shackleford Banks (USACE 2010a). This remote-sensing data confirms that proposed dredged material placement at the sites will not have any impact on exposed hard bottoms or associated marine life. Lastly, the use of the ODMDS will not adversely affect known hard bottom areas.

Impacts on State-designated Areas Important for Managed Species. Primary Nursery Areas (PNAs) are designated by the NC Marine Fisheries Commission and are defined by the State of North Carolina as tidal saltwater, which provide essential habitat for the early development of commercially important fish and shellfish (15 NC Administrative Code 3B .1405). Many fish species undergo initial post-larval development in these areas. This project will not impact PNAs because they are not present in the project impact area.

Impacts on the Marine Water Column. The potential water quality impacts of dredging and disposal are addressed in the following sentences. Dredging and disposal operations conducted during project construction may create impacts in the marine water column in the immediate vicinity of the activity potentially affecting the nearshore ocean area. These impacts may include minor and short-term suspended sediment plumes and related turbidity, as well as the release of soluble trace constituents from the sediment. During dredging, turbidity increases outside the dredging area should be less than 25 NTUs and are, therefore, considered insignificant. Overall water quality impacts of the proposed action are expected to be short-term and minor. Living marine resources dependent upon good water quality are not expected to experience significant adverse impacts due to water quality changes.

Scientific data are very limited with regard to the effects of disposal of dredged material on Bogue and Shackleford Banks on fishery resources. These effects may be similar, on a smaller scale, to the effects of storms; storm effects may include increased turbidity and sediment load in the water column and, in some cases, changes in fish community structure (Hackney et al. 1996).

Disposal of dredged material on the beaches of Bogue and Shackleford Banks may affect fishery resources and EFH through increases in turbidity and sedimentation that, in turn, may create localized stressful habitat conditions and may result in temporary displacement of fish and other biota. However, less than 200 feet of beach per day would be impacted, mobile biota, including juvenile and adult fish, should be able to relocate outside the more stressful conditions of the beach disposal area.

Impacts on Cape Lookout Sandy Shoals. The sandy shoals off Cape Lookout are located over 10 miles southeast of the entrance to Morehead City Harbor. No effects on these shoals are anticipated.

Impacts on Mud Bottoms. Mud bottoms will not be affected by this action.

Impacts of Larval Entrainment. Larvae and early juvenile stages of many species pose a greater concern than adults because their powers of mobility are either absent or poorly developed, leaving them subject to transport by tides and currents. This physical limitation makes them potentially more susceptible to entrainment by an operating pipeline and/or hopper dredges. Organisms close to the pipeline cutterhead or the hopper dredge draghead may be captured by the effects of its suction and may be entrained in the flow of dredged sediment and water. The intake of the dredge is principally below the sediment surface. As a worst-case, it may be assumed that entrained animals experience 100 % mortality, although some small number may survive. Due to the large numbers of larval organisms, it is not expected that entrainment mortality would adversely affect species population levels.

Impacts on other Habitat Areas of Particular Concern (HAPC). Tidal inlets comprise HAPC for several important species, including the planktonic larvae of brown shrimp, white shrimp, pink shrimp, as well as the eggs and larvae of red drum. These species are sometimes present in Beaufort Inlet, which is the location of the entrance channel to Morehead City Harbor. Therefore, channel dredging will likely impact the early life stages of these species through entrainment by suction dredging. While individual mortality is the result, population level impacts are considered to be insignificant.

The surf zone represents HAPC for adult bluefish and red drum that feed extensively in this portion of the ocean. Disposal operations along the beach can result in increased turbidity and mortality of intertidal macrofauna that serve as food organisms for these and other species. Therefore, feeding activities of these species may be interrupted in the immediate area of beach disposal. However, these mobile species are expected to temporarily relocate to other areas as the work proceeds along the beach. Once the disposal operation has passed, physical conditions in the impact zone quickly recover and biological recovery soon follow. Surf-feeding fish can then resume their normal activities in these areas. Therefore, these impacts are considered temporary and minor.

Impact Summary for Essential Fish Habitat. The proposed action is not expected to cause any significant adverse impacts to Essential Fish Habitat or EFH species. Impacts are expected to be minor on an individual and cumulative effects basis. Therefore, mitigation is not required.

No Action Alternative. Sediment would be disposed in Brandt Island, on the beaches of Bogue Banks, the existing and expanded Nearshore West, and within the ODMDS.

EFH for the No Action plan has already been assessed and approved by NMFS. The EA/FONSI dated 2009 for the Interim Operations Plan (USACE 2009a) stated that the No Action plan would not adversely impact EFH. NMFS has concurred with this determination.

Impact Summary for Essential Fish Habitat. The No Action plan would not be expected to cause any significant adverse impacts to Essential Fish Habitat or EFH species. Impacts are would be minor on an individual and cumulative effects basis. Therefore, mitigation is not required.

5.6 Wetlands and Floodplains

Proposed DMMP. No Section 404 jurisdictional wetlands will be filled by the proposed plan on the upland confined diked facility on Brandt Island, Bogue beaches, West and East Nearshore Placement areas, or the ODMDS. Therefore, no adverse impacts are anticipated for Section 404 jurisdictional wetlands.

Dredged material would be disposed in the floodplain adjacent to the Bogue and Shackleford Banks beaches. The proposed action is not anticipated to induce development of the floodplain, or to otherwise adversely affect any floodplain, since the existing oceanfront property on Bogue Banks is already developed and the oceanfront property on Shackleford Banks will never be developed since it is located within the Cape Lookout National Seashore.

On NPS-managed lands (i.e., Shackleford Banks): The National Park Service (NPS) classifies wetlands according to the U.S. Fish and Wildlife Service's "Classification of Wetlands and Deepwater Habitats of the United States" (Report FWS/OBS-79/31); Cowardin et al. 1979). These NPS designated wetlands are also subject to NPS D.O. #77-1 and its implementation procedures. Under the Cowardin definition, a wetland must have one or more of the following three attributes:

1. at least periodically, the land supports predominantly hydrophytes (wetland vegetation);
2. the substrate is predominantly undrained hydric soil; or
3. the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year.

The Cowardin wetland definition encompasses more aquatic habitat types than the definition and delineation manual used by the Corps of Engineers for identifying wetlands under Section 404 of the Clean Water Act. The 1987 “Corps of Engineers Wetlands Delineation Manual” and its regional supplements require that *all three* of the parameters listed above (hydrophytic vegetation, hydric soil, wetland hydrology) be present in order for an area to be considered a wetland. The Cowardin wetland definition includes such wetlands, but also adds some areas that, though lacking vegetation and/or soils due to natural physical or chemical factors such as wave action or high salinity, are still saturated or shallow inundated environments that support aquatic life (e.g., intertidal portions of shorelines that are unvegetated due to wave action).

Figure 6-1 shows the amount of existing intertidal Cowardin “wetlands” in the 3.65 mile disposal area on Shackleford Banks. These intertidal wetlands were delineated using the Cowardin wetland definition and classification system (see item 3 mentioned above). The non-vegetated tidal wetlands are located between the mean higher high water and mean lower low water contours on the ocean beach.

Intertidal unvegetated beach wetlands will be replaced with an unvegetated intertidal beach community. Please note the dredged material disposal interval on Shackleford Banks is every three years. Additionally, at any one time up to 2 miles of the 3.65 mile long disposal area on Shackleford Banks will be used. However, over the next twenty years it is expected that portions of the entire 3.65 mile long disposal area will be used. Assuming that the entire 3.65 miles long disposal area is used over the next 20 years, a maximum of about 27.5 acres of Cowardin “wetlands” will be filled as part of the DMMP.

The beach profile cross sections shown in Figure 6-2 displays the cross sectional length of the wetland zone for a typical profile within the Shackleford Banks disposal area. The blue line represents the pre-project typical beach condition while the red line represents the post-project evolved profile condition. The width of the defined wetland along the beach face is defined between the mean higher high water and mean lower low water contours. Figure 6-2 shows that disposal of compatible sediment along the beach face does not measurably change the width of the beach used to define the wetland area, rather this section of the beach is translated seaward the distance of the fill. Therefore, this means that the 27.5 acres filled within the 3.65 miles of disposal area on Shackleford Banks would result in the restoration of a similar amount or about 27.5 acres of Cowardin “wetlands”.

This meets the NPS "no-net-loss of wetlands" policy as stated in the NPS Procedural Manual #77-1. Intertidal areas that are exposed by the extreme low spring tide are considered wetlands. Since there will be a “no-net-loss of wetlands” to wetland habitat as a result of the proposed action, the DMMP project can be considered under the Restoration Exception in Section 4.2.1 (h) of NPS Procedural Manual #77-1. Sand grain size from the proposed donor dredge site is similar, or the same, as what is currently found in the beach intertidal zone. Temporary impacts to the existing wetlands will be unavoidable as this area will be replaced with sands to create a new beach intertidal area immediately to the south of the existing shoreline, but curvilinear enough to create the same shoreline farther offshore. It is anticipated that the natural ecological processes will, to the extent practicable, function at the site as they did prior to disturbance. This includes the re-establishment of the benthic community. Therefore, under the restoration excepted action a Wetland Statement of Findings does not need to be prepared.

The following BMP's will be observed:

1. Finished shoreline will have a similar slope as the existing shoreline.
2. Use of heavy equipment for smoothing of sand will leave no trace of disturbance when the disposal effort is complete.

No Action Alternative . No wetlands are known to have been impacted by the maintenance of the Morehead City Harbor navigation channels. Impacts to floodplains are temporary and insignificant.

5.7 Terrestrial Resources

In several areas along the ocean beach strand from the spit to the start of the beach disposal location on Shackleford Banks, there is no "dry" beach and the ocean waters come up to the base of the existing frontal dune during high tide. The USACE will ensure that the dredge contractor will not impact and/or undermine the existing frontal dune along the ocean strand from the spit to the disposal area on Shackleford Banks. This means that all beach equipment (dozers, pipeline sections, etc.) will be walked only during low tide along the beach strand to the disposal site. This also means that no dredge pipeline from the dredge to the disposal area will be aligned along the ocean beach strand from the spit to the disposal area on Shackleford Banks. The end of the dredge pipeline will be submerged offshore from the dredge working in the Harbor channels to just offshore of the disposal site on Shackleford Banks. Once the end of the dredge pipeline emerges onshore within the 3.65 mile long sediment disposal site (Figure 3-10), the contractor will set up the dump shack, fencing, light stands and stockpile additional shore pipe within the constructed upland area (waterward of the existing frontal dune). The existing frontal dune will not be adversely impacted by the contractor's equipment on Shackleford Banks.

For a number of years, the USACE has disposed of Harbor sediment on Fort Macon State Park and Atlantic Beach (including Pine Knoll Shores). In many years because of erosion at the Fort Macon State Park, the high tide has reached the base of the frontal dune. The bath house walkway area in the Park usually does not have a "dry" beach at high tide. In some years, the high tide even undermines the wooden walkway from the bath house to the beach. The USACE and its contractor have always made it a point to work with representatives of the State Park and the Towns to ensure that the frontal dunes are not impacted as a result of these disposal activities. In over 30 years, the contractor's personnel and equipment have never adversely impacted the frontal dunes on Bogue Banks.

The proposed DMMP will not adversely impact and/or undermine any frontal dunes on Bogue Banks or Shackleford Banks. Equipment will only be allowed waterward of the base of the frontal dune. No equipment will be authorized to temporarily cross or impact any frontal dune within the project area.

5.7.1 Vegetation

Proposed DMMP. The proposed DMMP is not anticipated to adversely impact vegetation since no vegetation is found within the existing upland diked disposal area on Brandt Island, the ocean beaches, nearshore areas off Bogue and Shackleford Banks, or the Morehead City ODMDS. Additionally, at this time there are no plans to expand or raise the Brandt Island dike.

Comparison of the volumetric losses calculated shows that the recent loss trends for both islands are relatively similar. The loss rate for the Bogue Banks side of the Inlet is approximately 219,000 cubic yards per year, while a similar loss rate along Shackleford Banks of 166,000 cubic yards per year was calculated. With this approximate 57/43 split of sediment entering the navigation channel from the west and east, respectively, material should be returned to the beaches in similar ratios during future beach disposal operations. Following the initial disposal, these ratios will be reevaluated based on the performance of the material placed. This will occur just prior to future disposal events to ensure equitable distribution of available material to both islands. The National Park Service (NPS) is the agency responsible for the management of Shackleford Banks, and has determined that only the quantity of material lost from the island as a result of the navigation channel can be returned to the beaches of Shackleford Banks. Quantities for the initial fill will be determined based on discussions with the NPS prior to dredging operations and shall not exceed the three year historic loss rate of volume of 499,350 cubic yards. To that end, the maximum amount of material to be disposed of along the beaches of Shackleford Banks following the initial fill will be the historic volumetric erosion rate of 166,000 cy/year multiplied by the duration between beach disposal events. As a result, any dredged quantities during beach disposal operations in excess of the amount required to satisfy the needs of the designated areas along Bogue and Shackleford Banks should be disposed of west of the designated disposal area on Bogue Banks (Stations 77-107). Figure 3-9 displays the designated disposal area on Bogue Banks for this material disposal, which should be disposed of west of Station 77 between Stations 59 and 76. Specific locations for disposal west of the Bogue Banks base location would be determined just prior to the commencement of dredging activities to determine the area that produces the greatest benefits while minimizing associated pumping costs.

According to the 3-year maintenance cycle (Section 3.4.2 Summary of Recommended Base Plan), the USACE proposes to place suitable dredged sediment within the 3.65 mile beach area on Shackleford Banks once every three years (i.e., in years 1, 4, 7, 10, etc.) starting in 2015. The proposed disposal area on Shackleford Banks is shown in Figure 3-10. The area of possible impact on the Shackleford beach is from about the toe of the existing dune to the -24 foot depth of closure. The existing frontal dune on

Shackleford Banks will not be impacted. The sediment disposed of below or waterward of the base of the existing frontal dune may range in height from about 6 feet NAVD and up to approximately 150 foot wide within the Shackleford Banks disposal area. Figure 4-8 shows the typical beach cross section of the proposed sediment berm in relationship to the existing frontal dune on Shackleford Banks.

Prior to any disposal of sediment on Shackleford Banks, the USACE and the NPS will fully coordinate this activity to ensure that all parties are aware of the consequences of this action. Moreover, prior to any disposal activities on Shackleford Banks a "Special Use Permit (SUP)", will be obtained from the NPS. The SUP will contain conditions and restrictions that the contractor must comply with prior to starting any work on Shackleford Banks. Before the contractor mobilizes their equipment to Shackleford Banks, the USACE, its contractor and the NPS will also meet to discuss all issues and decide on a work plan to ensure that there are no adverse impacts to Shackleford Banks. Lastly, the NPS will have the final say as to whether or not they want sediment disposed of on the island for any particular three year dredging cycle.

For each disposal event (on average once every three years) on Shackleford Beach, only about a third to a half of the 3.65 mile disposal area on Shackleford Banks would be impacted with disposal of Harbor sediment. After each beach disposal (once every three years), the next occurrence would be located in another portion of the 3.65 mile disposal area. The USACE would alternate disposal areas within the 3.65 mile long beach disposal area on Shackleford Banks and not use the same disposal area time after time.

By placing 90% or better coarse-grained sediment with similar color on 3.65 miles of beach on Shackleford Banks, the ongoing shoreline erosion would be reduced. Failure to reduce the existing shoreline erosion would mean that the ongoing erosion would continue unabated.

No Action Alternative. Implementation of the No Action alternative would not adversely impact any vegetation since no vegetation is found within any designated disposal sites (i.e., Brandt Island, beaches and nearshore area off Bogue Banks, or the ODMDS).

The No Action alternative would not result in the disposal of 90% or greater sand with similar color on Shackleford Banks. Failure to place suitable sediment on Shackleford Banks will result in continued erosion.

5.7.2 Wildlife

Proposed DMMP. The proposed DMMP is not expected to adversely impact terrestrial resources found on Brandt Island and along the beach or the dune areas of Bogue and Shackleford Banks. Bull-dozers may be used to place the dredge pipe within Brandt Island but no significant amount of vegetation would be removed.

There are no plans at this time to modify the Brandt Island upland diked disposal area therefore terrestrial resources will not be adversely impacted. No vegetation or habitats on Brandt Island would be removed and/or adversely impacted. As previously stated, should modifications to Brandt Island be deemed feasible in the future, an EA will be prepared and all appropriate environmental clearances will be obtained.

Migratory birds may also use Brandt Island for foraging, nesting, and roosting habitat within the migratory bird nesting season from April 1 to August 31 of any year. However, the NC Wildlife Resources Commission indicates that they consider Brandt Island as low quality migratory bird habitat for the following reasons:

1. Brandt Island is not isolated from Bogue Banks. A small and shallow 25-foot wide tidal creek (Fishing Creek) separates Brandt Island from Bogue Banks. Raccoons and other predators (i.e., cats, dogs, etc.) can reach the island and destroy nests.

2. The NC Wildlife Resources Commission indicates that island heights above 10 feet expose birds and their nests to higher winds and sand movement. The top of the existing dike on Brandt Island is about 40-feet in elevation. Moreover, Brandt Island is heavily vegetated with only a small amount of sandy areas.

If any work is initiated on Brandt Island within the migratory bird nesting season (April 1 to August 31), USACE would coordinate with representatives from the NC Wildlife Resources Commission to ensure that migratory bird nesting is not adversely impacted.

Migratory shorebirds are also found along the beaches of Bogue and Shackleford Banks and may use this area for foraging and roosting habitat. Disposal of coarse-gained sediment along the beaches of Bogue and Shackleford Banks will have no adverse effect on migratory shorebirds. A recent year round study in Brunswick County, NC documents observed shorebird use there (USACE 2003). This report indicated that disposal of beach compatible sediment on the beaches in Brunswick County had no measurable impact on bird use.

Therefore, bird species protected by the Migratory Bird Treaty Act of 1918, as amended, would not be adversely affected by the Proposed DMMP.

No long-term adverse impacts to terrestrial resources on Brandt Island, the beaches or dune areas of Bogue and Shackleford Banks are anticipated.

No Action Alternative. Migratory birds may also use Brandt Island for foraging, nesting, and roosting habitat within the migratory bird nesting season from April 1 to August 31 of any year. However, as stated above, the NC Wildlife Resources Commission considers Brandt Island as low quality migratory bird habitat.

As with the proposed plan, if work is initiated on Brandt Island within the migratory bird nesting season (April1 to August 31), the USACE would coordinate with representatives from the NC Wildlife Resources Commission to ensure that migratory bird nesting is not adversely impacted.

Migratory shorebirds are found along the beaches of Bogue Banks and use this area for foraging and roosting habitat. Disposal of coarse-grained sediment along the beaches of Bogue Banks would have no adverse effect on migratory shorebirds.

The No Action plan is not expected to adversely impact any terrestrial resources found on Brandt Island and along the beach or the dune areas of Bogue Banks.

5.8 Threatened and Endangered Species (includes State Protected Species)

On September 30, 2013, the USFWS published in the Federal Register (50 CFR Part 17) their proposal to list the red knot (*Calidris canutus rufa*) as a threatened species under the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531–1543).

On March 25, 2013, the USFWS published in the Federal Register (50 CFR Part 17) their proposal to designate specific areas in the terrestrial environment as critical habitat for the Northwest Atlantic Ocean Distinct Population Segment of the threatened loggerhead sea turtle (*Caretta caretta*) under the ESA. The proposed critical habitat is located in coastal counties in North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi.

Within the proposed dredged material disposal areas for the Morehead City Harbor DMMP, the beaches of Bogue Banks have been designated in the proposed USFWS Critical Habitat Rule as the Northern Recovery Unit, North Carolina, LOGG-T-NC-01 (Bogue Banks in Carteret County) for the loggerhead sea turtle. This unit extends from Beaufort Inlet to Bogue Inlet and includes terrestrial lands from the Mean High Water (MHW) line landward to the toe of the secondary dune or developed structures.

Additionally, on July 18, 2013, the NMFS published in the Federal Register (50 CFR 226) their proposal to designate specific areas in the marine environment as critical habitat for the Atlantic Ocean loggerhead sea turtle Distinct Population Segment (DPS) (*Caretta caretta*) within the Atlantic Ocean under the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531–1543). In the Morehead City Harbor project area, NMFS is proposing to designate two unit descriptions for the loggerhead sea turtle: LOGG-N-2 – Southern Portion of the North Carolina Winter Concentration Area and LOGG-N-3 – Bogue Banks and Bear Island, Carteret and Onslow Counties, NC. The LOGG-N-2 unit is winter habitat only and includes waters from 20 meters (65.6 feet) to 100 meters (328 feet) depth contours. The LOGG-N-3 unit contains nearshore reproductive habitat only and consists of the nearshore ocean from Beaufort Inlet to Bogue Inlet and seaward 1.6 km (1 mile). This unit contains an area adjacent to high density nearshore reproductive habitat (Beaufort Inlet to Bogue Inlet) as well as an area of high density nearshore reproductive habitat (Bogue Inlet to Bear Inlet). Only the LOGG-N-3 unit would be applicable to the proposed Morehead City Harbor DMMP. Unit LOGG-N-2 would not be applicable to the DMMP, since all existing Federal navigation channels and disposal areas are in water depths less than 20 meters (65.6 feet).

Currently, both USFWS' and NMFS' proposals for designating critical habitat for the threatened loggerhead sea turtle have not been finalized. Moreover, the above mentioned unit descriptions for both USFWS and NMFS could change prior to the final critical habitat designations.

Proposed DMMP. Operational precautions such as adherence to the aforementioned dredging windows for beach disposal minimize potential for impacts to shorebirds, sea turtles, West Indian manatees, and whales. Additionally, should sediment be placed directly in the nearshore areas by pipeline dredge, this work would occur from January 1 to March 31, also minimizing impacts to shorebirds, sea turtles, West Indian manatees, sturgeon, and whales.

In the Morehead City Harbor, hopper dredging takes place only from January 1 to March 31 of any year in accordance with the terms and conditions of the Regional Biological Opinion on hopper dredging by NOAA Fisheries, dated September 25, 1997 (NMFS 1997). NMFS Biological Opinion dated September 25, 1997 authorizes the continued hopper dredging of channels and borrow areas in the southeastern United States.

On 18 September 2008, the USACE provided NMFS with a revised Draft South Atlantic Regional Biological Assessment (SARBA). The USACE' SARBA would authorize the following activities: "*Dredging activities in the coastal waters, navigation channels (including designated Ocean Dredged Material Disposal Sites (ODMDS)), and sand mining areas in the South Atlantic Ocean from North Carolina/Virginia Border through and including Key West, Florida and the Islands of Puerto Rico and the U.S. Virgin Islands (USVI)*". Once NMFS provides the USACE with their Biological Opinion, any new conditions or restrictions would supersede the NMFS Biological Opinion dated September 25, 1997. Hopper dredging within the Morehead City Harbor would comply with any new conditions and/or restrictions of the new NMFS BO.

Disposal of dredged material in the Morehead City ODMDS, the upland diked disposal area on Brandt Island, the nearshore areas off Bogue and Shackleford Banks, or pumped directly onto the oceanfront of Bogue and Shackleford Banks would be undertaken in accordance with the terms and conditions of the Morehead City Harbor Biological Opinion issued by the USFWS dated December 7, 1989 and amended April 19, 1993 and July 22, 2003. Should any threatened or endangered species be observed during implementation of Morehead City Harbor DMMP activities, actions to avoid a "take" will be conducted.

The Wilmington District routinely conducts monitoring for seabeach amaranth on Bogue Banks. Observed numbers of plants are highly variable, ranging from zero to 250 plants in a reach for the Fort Macon, Atlantic Beach and Pine Knoll Shores, portions of Bogue Banks. The NPS also routinely conducts monitoring for seabeach amaranth on Shackleford Banks and plans to continue to monitor for this species.

Beach disposal of sand will be conducted between November 16 and April 30 on Bogue Banks and between November 16 and March 31 on Shackleford Banks to the degree practicable, in order to minimize potential impacts on nesting sea turtles. Also, after disposal of dredged material, any affected beach will be monitored for hardness and areas exceeding 500 Cone Penetrometer Units (CPU) will be tilled in order to make them more suitable for sea turtle nesting. Thus, any adverse impacts on sea turtles should be minor. In addition, the portion of beach that receives sand should provide improved nesting habitat for sea turtles as compared to the currently eroded condition of the beach disposal areas.

Placement of coarse-grained material (greater than or equal to 80% sand) from the Morehead City Inner Harbor by pipeline dredge in the nearshore areas off Bogue and Shackleford Banks is not recommended as part of the base plan, but may be a viable option in the future. This option would involve the placement of approximately 150,000 cubic yards of maintenance dredged material on average, once every three years. This activity would not adversely impact any listed species within the project area as work would be conducted during the winter months (January 1 through March 31).

By placing beach compatible material within the proposed 3.65 mile beach disposal area on Shackleford Banks, the USACE believes that this would increase the acres of designated critical habitat for the Wintering Piping Plover. Up to half of the 3.65 mile long disposal area would be impacted during any three year dredging cycle. The proposed 150 foot wide disposal berm would extend from the base of the existing frontal dune to the -24 foot depth. Up to 33 acres (150 foot wide times 9,636 foot long divided by 43,560) of new ocean beach could be created every 3 years about 1 mile east of the Shackleford spit off Beaufort Inlet. As indicated in Section 4.8 Terrestrial Resources, some portions of the ocean beach on Shackleford Banks have eroded up to 150 meters since 1974.

SUMMARY EFFECT DETERMINATION

Threatened and endangered species summary effect determination for beach disposal and dredging activities associated with the proposed project area (No Effect (NE – green); May Affect Not Likely to Adversely Affect (MANLAA – orange); May Affect Likely to Adversely Affect (MALAA – red), and Not Likely to Adversely Modify (NLAM - orange) Critical Habitat.

	Listed Species Within Project Area	**Effect Determination**	
		Beach Placement Activities (USFWS)	**In-Water Dredging Activities (NMFS)**
Sea Turtles	**Leatherback**	MANLAA	MANLAA
	Loggerhead	MANLAA	MALAA
	Green	MANLAA	MALAA
	Kemp's Ridley	NE	MALAA
	Hawksbill	NE	MALAA
Large Whales	**Blue, Finback, Sei, and Sperm**	NE	NE
	NARW	NE	MANLAA
	Humpback	NE	MANLAA
	West Indian Manatee	NE	MANLAA
	Roseate Tern	NE	NE
	Red Knot	MANLAA	NE
	Piping Plover and Critical Wintering Habitat	MANLAA/NLAM	NE
	Atlantic Sturgeon	NE	MALAA
	Shortnose Sturgeon	NE	NE
	Smalltooth Sawfish	NE	NE
	Seabeach Amaranth	MANLAA	NE
	Rough-Leaved Loosestrife	NE	NE
	rare butterfly (*Atrytonopsis* new species 1)	NE	NE
	American Alligator	NE	NE
	Eastern Cougar	NE	NE
	Red-cockaded Woodpecker	NE	NE

(Table notes: No Effect (NE = green), May Affect Not Likely to Adversely Affect (MANLAA = orange), and May Affect Likely to Adversely Affect (MALAA = red))

Table 5-5. T & E species effects determination for beach disposal and dredging activities associated with the DMMP

A biological assessment (BA) has been completed (Appendix J) and will be coordinated with USFWS and NMFS during the NEPA process. As indicated in Section 5.00 of the BA (Commitments to Reduce Impacts), the USACE will comply with all previous agreements with the resource agencies. With these commitments in place, for any USFWS terrestrial environment designated as critical habitat, such as LOGG-T-NC-01 (Northern Recovery Unit, North Carolina) , the proposed project will not result in an adverse modification of critical habitat for the threatened loggerhead sea turtle.

Additionally, pursuant to the NMFS Biological Opinion (BO) dated September 25, 1997 and the 2008 USACE revised Draft South Atlantic Regional Biological Assessment (SARBA), the continued hopper dredging of existing navigation channels is authorized and the USACE would comply with all conditions and/or restrictions. Hopper dredging activities will not result in an adverse modification of the NMFS' proposed critical habitat for the threatened loggerhead sea turtle (LOGG-N-3).

State Protected Species (vascular plants and vertebrate animals) are also found on Bogue and Shackleford Banks (Table 4-9). The DMMP impact area would be considered the ocean beaches and nearshore areas off Bogue and Shackleford Banks. The majority of these state protected species in the project area would be shorebirds that use the beaches of Bogue and Shackleford Banks for foraging and roosting habitat. Disposal of coarse-gained sediment along the beaches of Bogue and Shackleford Banks will have no adverse effect on shorebirds. A recent year round study in Brunswick County, NC documents observed shorebird use there (USACE 2003). This report indicated that disposal of beach compatible sediment on the beaches in Brunswick County had no measurable impact on bird use. Implementation of the proposed Morehead City Harbor DMMP is not expected to adversely impact State Protected Species.

No Action Alternative. The same operational precautions described above for the proposed DMMP, such as adherence to dredging windows and the terms and conditions of both the NOAA Fisheries' and USFWS' Biological Opinions, would minimize the potential impacts to shorebirds, sea turtles, West Indian manatee, and whales.

Under the No Action alternative, the Wilmington District would continue to monitoring for seabeach amaranth on Bogue Banks. Beach disposal of sand would be conducted between November 16 and April 30 to the degree practicable, in order to minimize potential impacts on nesting sea turtles. Also, after disposal of dredged material, any affected beach area would be monitored for hardness and areas exceeding 500 CPUs would be tilled in order to make the area more suitable for sea turtle nesting. Thus, any adverse impacts on sea turtles should be minor. In addition, the portion of beach that receives sand should provide improved nesting habitat for sea turtles as compared to the currently eroded condition of the beach disposal areas.

No adverse impacts to Threatened and Endangered species are anticipated, since the USACE will abide by all conditions and restrictions of the NOAA Fisheries and USFWS BO's.

5.9 Cultural Resources

It is anticipated that resources in the area will be limited to shipwrecks that may be impacted by direct deposit of dredged material or by induced changes in current patterns. Dredged material disposal impacts to submerged cultural resources are often considered benign; however, assessment of impacts must consider the susceptibility of known resources to three major routes of impact: direct impact from placement of material, the chemical composition of the dredged material and its potential to erode a site, and the potential for changes in bottom contours to affect current patterns and influence the deposition environment.

Archival records and past investigations by private firms, the State of North Carolina, and the Wilmington District have located and identified several important shipwrecks in the Beaufort Inlet vicinity. In addition, magnetic and acoustic anomalies have been identified in the proposed Bogue and Shackleford nearshore placement areas (USACE 2010a).

The continued maintenance of Morehead City Harbor will not adversely impact the Fort Macon historic site. Since 1910, the Corps has maintained Morehead City Harbor. The USACE Section 111 report (USACE 2001) determined that the historic beach disposal activities have ameliorated any shoreline impacts related to the dredging of the navigation channel. Additionally, the Section 111 report (USACE 2001) determined that there were no significant changes to the shoreline recession rate beyond the Atlantic Beach town limits that are related to the navigation project.

Proposed DMMP. Direct project impacts will be limited to submerged cultural resources and are likely to be minimal. The actual extent of impact will depend on the amount of material placed on or near cultural resources and the chemical composition of the material. If beach quality or near beach quality material is deposited, chemical impacts will be minimal or non-existent. If dredged material release locations are specified in the contract and are monitored so that no mounding occurs on or near cultural resources, then effects from altered current are also likely to be minimal or non-existent.

The Underwater Archaeology Branch (UAB) of the North Carolina Office of State Archaeology will be consulted prior to dredging and disposal activities. Furthermore, UAB will be provided the hydrographic data resulting from the monitoring plan. The data, particularly in the areas of known or suspected cultural resources, will allow the Wilmington District and UAB to assess any project effects on cultural resources within the project area.

A special restricted zone will be required in the vicinity of the *Queen Anne's Revenge*, west of Beaufort Inlet. This area continues to be actively surveyed by both public and private interests. An Admiralty Claim may be in effect at the time of project implementation and could effectively limit the areas within which dredges might operate.

The Morehead City Harbor DMMP study has been reviewed for possible cultural resources impacts pursuant to Section 106 of the National Historic Preservation Act (16 USC 470 et seq.), the Abandoned Shipwreck Act (43 USC 2101 et seq.), and North Carolina statute G.S. 121-22 to 28, Article 3, which gives the state control of salvaged of abandoned shipwrecks and other underwater archaeological material on all bottoms from low water to one marine league seaward and on bottoms of other navigable waters. The DMMP project review is being conducted in accordance with implementing regulations found at 36 CFR 800, *Protection of Historic Properties*.

This review has included past research reports, consultation with the North Carolina State Historic Preservation Officer and staff of the NC Division of Archives and History Underwater Archaeology Unit. The review indicates that six archaeological sites have been recorded along the Bogue Banks beaches and two have been recorded offshore. In addition, archaeologists have identified numerous clusters of offshore magnetic and sonar targets, some of which have been verified as cultural remains. Some of the known sites consist of transient wreckage that has washed ashore from ships lost nearby in offshore waters. The verified sites and their last known locations are (NAD83 datum, UTM Zone 18):

0001BBB Iron Steamer Pier Wreck Site (3840366N, 0332561E)
Believed to be the Civil War blockade-runner *Pevensey*, an iron-hull side-wheel steamer, lost June 9, 1864. The wreck is located approximately 100 yards offshore on the east side of the pier lying almost parallel to the beach. Portions of a paddle wheel are visible during low tide.

0002BBB Gun Emplacement Site (3838105N, 0317035E)
Granite stones located in the surf zone adjacent to the 6200 block of Ocean Drive at Emerald Isle, believed to be from a World War II coastal shore battery exposed by beach erosion.

0003BBB Salter Path Site (No position given)
Ship timbers 14” square, approximately 42 feet and 18 feet long with 1.25” diameter iron fasteners located roughly 1200 feet east of the beach access road near Squatters Campground.

0004BBB Cupola Site (3839081N, 0322515E)
Portions of a ship hull approximately 30’ long and 14’ wide fastened with iron pins, yellow pine planking on oak frames. This site is located in the surf zone near 18th Street, Emerald Isle. (Tag Numbers 134, 135)

0005BBB Emerald Isle Pier Wreck (3838758N, 0320674E)
Ship timber 40’ long, 12” x 18” square, iron fasteners and one attached frame. This site is located near Emerald Isle Fishing Pier. (Tag Numbers 155, 156)

0006BBB Ocean Reef Site (3838806N, 0320892E)
Ship wreckage covering an area of approximately 100’ by 35’ near the Ocean Reef Condos (marked by a warning sign on the beach). This site consists of extensive debris with iron fasteners.

0003BUI Queen Anne’s Revenge (location restricted). This shipwreck dates to 1718 and was the primary vessel of the pirate, Black Beard. This site is listed on the

National Register of Historic Places and is managed by the NC Division of Archives and History.

0000SFB Quinnabaugh. This site is located offshore of Shackleford Banks, east of Beaufort Inlet. The site has been visited by research divers and appears to be the remains of steam machinery from the wreck.

Prior to any disposal of dredged material on Shackleford Banks, the USACE will walk the staging, construction corridor (between the toe of the ocean dune to the MLW contour) and the 3.65 mile disposal area to ensure that no archaeological sites would be adversely impacted by the proposed action.

If a pipeline dredge is used for direct placement in the nearshore placement areas, a spill barge would need to be anchored within the nearshore areas to direct the discharge of sediment from the pipeline dredge. In order to avoid cultural resources, both the pipeline route (from the dredge to the nearshore area) and the location of the spill barge anchoring area would be coordinated with the NC State Historic Preservation Office (SHPO) and UAU.

The USACE agrees to work closely with the NC State Historic Preservation Office (SHPO) and UAU regarding the placement of sediment in the nearshore areas off Bogue and Shackleford Banks. Additionally, copies of all surveys of the Beaufort Inlet area will be provided to these agencies. The proposed DMMP will not adversely impact cultural resources.

No Action Alternative. Continued maintenance dredging of Morehead City Harbor channels and use of approved disposal areas would not have adverse effects on cultural resources.

5.10 Esthetic and Recreational Resources (Including Soundscape)

Proposed DMMP. Expansion of the beach area would improve esthetics and recreational quality for beach users. Recreation benefits for the proposed project would result from increased quality of the recreation experience. The esthetic quality of the Bogue and Shackleford Banks beaches would be temporarily impacted by the noise and visual intrusion of the dredge and associated pipes and equipment during disposal of dredged material on the beach. Within the sediment placement areas off Bogue and Shackleford Banks, boat and human traffic access would be restricted for safety reasons during placement activities. Additionally, since all work on these beaches would take place during the off season (November 16 to April 30 on Bogue Banks and November 16 to March 31 on Shackleford Banks) and up to a maximum of 200 feet a day, the USACE believes that these impacts are temporary and not significant. When suitable sediment is disposed on Shackleford Banks, the natural soundscape of the Cape Lookout National Seashore would be impacted by the contractor’s equipment (crew, dozers, shore pipe, dump shack, etc.) within the disposal area. However, work on Shackleford Banks would only occur during the off season and on average of once every three years. The USACE believes that these infrequent impacts to soundscape on Shackleford Banks would be temporary and not significant.

No Action Alternative. The No Action alternative has improved and expanded the existing beaches within the town of Atlantic Beach and Fort Macon State Park and this would be expected to continue. Only beaches on Bogue Banks would be impacted. Recreation benefits have increased due to the increase of the existing beaches on Bogue Banks. During disposal activities the esthetic quality of the Bogue Banks beaches would be temporarily impacted by the noise and visual intrusion of the dredge, associated shore pipes, temporary safety fencing, and equipment during disposal of dredged material on the beach. However, all work would be conducted during the off-season (16 November to April 30) and the work area on the beach extends a maximum of 200 feet a day. Therefore, the USACE believes that these impacts would be temporary and insignificant.

5.11 Recreational and Commercial Fishing

Proposed DMMP. Beach disposal on both Bogue and Shackleford Banks will proceed up or down the beach progressing at slow rate of about one mile a month or 200 feet of beach per day. Fishing activities (such as surf or seine fishing from the beach strand or from the two ocean piers) will be precluded from the immediate vicinity of the discharge during construction and maintenance. During past beach disposal events, a buffer on either side of these ocean piers has been maintained so as not to adversely impact these structures. Employment of buffers during future beach disposal events would be coordinated with the appropriate pier owners. Portions of the project area that have been recently completed and those awaiting disposal would be accessible for fishing. The immediate construction area is small relative to nearby available fishing areas that could be accessed by numerous beach access points located throughout the project area. Discharge pipelines along the beach that cross established vehicle access points would be ramped as practical to facilitate continued use.

Commercial trawlers would not be able to operate in dredging areas and in any immediate areas occupied by pipelines during maintenance operations. No permanent disposal of equipment is proposed. Dredging with beach disposal is proposed to occur from November 16 through April 30 for Bogue Banks and from November 16 through March 31 for Shackleford Banks during any year of the DMMP. However, dredging accomplished after March 31would most likely involve disposal of material in Brandt Island, thereby not impacting recreational or commercial fishing. No permanent placement of equipment is proposed. Only a limited area of open-ocean would be occupied by equipment (hopper and pipeline dredges) in relation to available fishing areas.

No Action Alternative. Fishing activities (such as surf or seine fishing from the beach strand) would not be precluded for a majority of the time due to limited beach disposal. Portions of the project area that have been recently completed and those awaiting disposal would be accessible for fishing. There would be no change in recreational fishing opportunities from those currently in existence along the beach strand.

Commercial trawlers would not be able to operate in construction areas. No permanent placement of equipment is proposed. Only a limited area of open-ocean would be occupied by equipment (i.e., hopper and pipeline dredges) in relation to available fishing areas.

5.12 Socioeconomics

Proposed DMMP. Implementation of the proposed plan would not result in any adverse effects to any socioeconomic resources. Positive benefits are expected as a result of disposal of coarse-grained dredged material on portions of the oceanfront of Bogue and Shackleford Banks. Continued disposal of sand on the beaches of Bogue Banks may contribute to increased beach real estate values and reduce anthropogenic effects. Disposal of sand on Shackleford Banks would reduce anthropogenic effects to the island. These proposed sand disposal activities on both Bogue and Shackleford Banks would also increase benefits to tourism in the area.

No Action Alternative. Continuation of the No Action plan will not result in any adverse effects to socioeconomic resources. Positive benefits are expected as a result of disposal of coarse-grained dredged material on portions of the ocean front of Bogue Banks. Continued sand disposal on the beaches of Bogue Banks may contribute to increased beach real estate values, tourism in the area, and reduce anthropogenic effects.

5.13 Other Significant Resources (Section 122, P.L. 91-611)

5.13.1 Air, Noise, and Water Pollution

a. Air Quality. The air quality in Carteret County, North Carolina, is designated as an attainment area (Section 4.4 Air Quality). The State of North Carolina does have a State Implementation Plan ("SIP") approved or promulgated under Section 110 of the Clean Air Act (CAA), as amended. However, a conformity determination is not required because Carteret County has been designated by the State of North Carolina as an attainment area, and the direct and indirect emissions from the project fall below the prescribed *de minimus* levels (58 Fed. Reg. 93.153(c)(1)) and; therefore, no conformity determination would be required.

Implementation of the proposed DMMP or the No Action plan would not adversely impact air quality in the project area.

b. Noise. Noise in the outside environment associated with beach and nearshore placement activities would be expected to minimally exceed normal ambient noise in the project area; however, construction noise would be attenuated by background sounds from wind and surf. In-water noise would be expected in association with the dredging and placement activities for this project. Specifically, noise associated with dredging could occur from (1) ship/machinery noise—noise associated with onboard machinery and propeller and thruster noise, (2) pump noise—noise associated with pump driving the suction through the pipe, (3) collection noise—noise associated with the operation and collection of material on the sea floor, (4) deposition noise—noise associated with the placement of the material within the barge or hopper, and (5) transport noise—noise associated with transport of material up the suction pipe. The limited available data indicate that dredging is not as noisy as seismic surveys, pile driving and sonar; but it is louder than, for example, most shipping, operation of offshore wind turbines and drilling (Thomsen et al. 2009).

Dredging produces broadband and continuous, low-frequency sound (below 1 kHz) and estimated source sound pressure levels range between 168 and 186 dB reference (re) level of 1 μPa at 1 m (A micropascal (μPa) is a measurement of pressure commonly applied to underwater sound and 1 pascal is equal to the pressure exerted by one newton over one square meter.), which can trigger avoidance reaction in marine mammals and marine fish. In some instances, physical auditory damage can occur. Auditory damage is the physical reduction in hearing sensitivity due to exposure to high-intensity sound and can be either temporary (temporary threshold shift) or permanent (permanent threshold Shift) depending on the exposure level and duration. Other than physical damage, the key auditory effect is the increase in background noise levels, such that the ability of an animal to detect a relevant sound signal is diminished, which is known as *auditory masking*. Masking marine mammal vocalizations used for finding prey, navigation and social cohesion could compromise the ecological fitness of populations (Compton et al. 2008).

According to Richardson et al. (1995) the following noise levels could be detrimental to marine mammals: Prolonged exposure of 140 dB re (level of) 1 μPa/m (continuous man-made noise), at 1 km can cause permanent hearing loss. Prolonged exposure of 195 to 225 dB re (level of) 1 μPa/m (intermittent noise), at a few meters or tens of meters, can cause immediate hearing damage.

According to Richardson et al. (1995), "Many marine mammals would avoid these noisy locations, although it is not certain that all would do so." In a study evaluating specific reaction of bowhead whales to underwater drilling and dredge noise, Richardson et al. (1990) also noted that bowhead whales often move away when exposed to drillship and dredge sound; however, the reactions are quite variable and can be dependent on habituation and sensitivity of individual animals. According to Richardson et al (1995), received noise levels diminish by about 60 dB between the noise source and a radius of 1 km. For marine mammals to be exposed to a received level of 140 dB at 1-km radius, the source level would have to be about 200 dB re (level of) 1 μPa/m. Furthermore, few human activities emit continuous sounds at source levels greater than or equal to 200 dB re (level of) 1 μPa/m; however, supertankers and icebreakers can exceed the 195 dB noise levels.

According to Clarke et al. (2002), hopper dredge operations had the highest sustained pressure levels of 120–140 dB among the three measured dredge types; however, the measurement was taken at 40 m from the operating vessel and would likely attenuate significantly with increased distance from the dredge. On the basis of (1) the predicted noise effect thresholds noted by Richardson et al. (1995), (2) the background noise that already exists in the marine environment, and (3) the ability of marine mammals to move away from the immediate noise source, noise generated by bucket, cutterhead, and hopper dredge activities would not be expected to affect the migration, nursing/breeding, feeding/sheltering or communication of large whales. Although behavioral effects are possible (i.e., a whale changing course to move away from a vessel), the number and frequency of vessels present in a given project area is would be small, and any behavioral impacts would be expected to be minor. Furthermore, for hopper dredging activities, endangered species observers would be onboard and would record all large whale sightings and note any potential behavioral impacts. Per the standard USACE specifications for all dredging projects, the USACE and the contractor would keep the date, time, and approximate location of all marine mammal sightings. Care would be taken not to closely approach (within 300 ft.) any whales, manatees, or other marine mammals during dredging operations or transportation of dredged material. An observer would serve as a lookout to alert the dredge operator or vessel pilot or both of the occurrence of the animals. If any marine mammals are observed during other dredging operations, including vessel movements and transit to the dredged material disposal site, collisions must be avoided either through reduced vessel speed, course alteration, or both. During the evening hours, when there is limited visibility from fog, or when there are sea states of greater than Beaufort 3 (wind speed of 8-12 miles per hour), the dredge must slow down to 5 knots or less when transiting between areas if whales have been spotted within 15 nautical miles of the vessel's path in the previous 24 hours. Sightings of whales or manatees (alive, injured, or dead) in the work area must be reported to NMFS Whale Stranding Network.

Similar to conclusions made regarding effects of sound on marine mammals, non-injurious impacts to sea turtles may also occur because of acoustic annoyance or discomfort. It has been hypothesized, on the basis of anatomical studies that sea turtle hearing range centers around low-frequency sounds. Ridgeway et al. (1969 and 1970) evaluated the frequency sensitivity of green sea turtles and found that green turtles detect limited sound frequencies (200–700 Hz) and display high level of sensitivity at the low-tone region (approx 400 Hz). According to Bartol et al. (1999), the most sensitive threshold for loggerhead sea turtles is 250–750 Hz with the most sensitive threshold at 250 Hz. Though noise generated from dredging equipment is within the hearing range of sea turtles, no injurious effects would be expected because sea turtles can move from the area, and the significance of the noise generated by the dredging equipment dissipates with an increasing distance from the noise source.

Proposed DMMP. The proposed DMMP will not significantly increase the noise in the project area. Temporary and short-term increases in noise levels are anticipated during construction activities on both Bogue and Shackleford Banks but all work will occur during the off season (November 16 to April 30 on Bogue Banks and November 16 to

March 31 on Shackleford Banks for pipeline dredges) and within a small footprint on the beach. Therefore, no adverse impacts are anticipated.

No Action Alternative. The No Action alternative has not significantly increased the noise levels in the project area. Temporary and short-term increases in noise levels are anticipated during construction activities on Bogue Banks but all work would occur during the off season (November 16 to April 30 of any year for pipeline dredges) and within a relatively small footprint on the beach. No adverse impacts have occurred as a result of this activity.

c. Water Pollution. Water Quality in the project area is thoroughly discussed in Section 5.3.01 of the Integrated DMMP and DEIS. No adverse impacts are anticipated for both the proposed DMMP and the No Action alternative.

5.13.2 Man-made & Natural Resources, Esthetic Values, Community Cohesion, & Availability of Public Facilities & Services

No adverse impacts to Man-made and Natural Resources, Esthetic Values, Community Cohesion, and the Availability of Public Facilities and Services are expected as a result of the Proposed DMMP or the No Action plan.

5.13.3 Hazardous, Toxic and Radioactive Wastes (HTRW)

No HTRW sites are located in the project area and therefore neither the proposed DMMP nor the No Action plan will impact any HTRW sites. Also, neither plan would result in the disposal of contaminated sediments in any disposal areas within the project area.

5.14 Employment, Tax, and Property Values

No adverse effects on employment, tax, and property value are expected as a result of the proposed DMMP or the No Action plan.

5.15 Displacement of People, Businesses, and Farms

No people, homes or businesses will be displaced by the proposed DMMP or No Action plan. Additionally, there will be no utility relocations. Also, no farms would be affected by the proposed DMMP or the No Action plan.

5.16 Community and Regional Growth

Communities in the Morehead City Harbor vicinity have been experiencing rapid growth during the last few decades. This growth is expected to continue with or without the proposed DMMP or No Action plan.

5.17 Wilderness Character

As noted previously, the NPS has proposed that approximately 2,990 acres at the Shackleford Banks portion of Cape Lookout National Seashore be designated as wilderness pursuant to the Wilderness Act of 1964. The essential characteristics of wilderness, as outlined in NPS *Management Policies* (2006) Section 6.2.1.1, are as follows:

- The earth and its community of life are untrammeled by humans, where humans are visitors and do not remain.
- The area is undeveloped and retains its primeval character and influence without permanent improvements or human habitation.
- The area generally appears to have been affected primarily by the forces of nature, with the imprint of humans' work substantially unnoticeable.

- The area is protected and managed so as to preserve its natural conditions.
- The area offers outstanding opportunities for solitude or a primitive and unconfined type of recreation.

In assessing impacts to wilderness character, NPS has looked to a protocol that it and other federal land management agencies have developed for monitoring impacts to wilderness character. This protocol directs NPS to measure impacts such as the following:

- unauthorized (user-created) and authorized physical development in wilderness;
- amount of visitor use / number of visitor contacts;
- area of wilderness affected by access or travel routes outside of, but adjacent to, the wilderness;
- extent and magnitude of intrusions on the natural soundscape from inside and outside the wilderness;
- type and number of agency-provided recreation facilities; and
- type and extent of management restrictions on visitor behavior to protect resources.

For each of the foregoing types of impacts, the more instances detected by monitoring, the greater the degradation to wilderness character.

Proposed DMMP. As noted previously, the NPS has proposed that approximately 2,990 acres at the Shackleford Banks portion of Cape Lookout National Seashore be designated as wilderness pursuant to the Wilderness Act of 1964. Congress has not designated Shackleford Banks as wilderness. However, the NPS manages Shackleford Banks as if it were wilderness. Under the proposed DMMP, opportunities for solitude would be substantially impacted every three years during times of active sediment disposal. Since all work at Shackleford Banks would take place during the off season (November 16 to March 31) and a relatively small area of beach would be impacted each day (up to a maximum of 200 feet), impacts would be temporary and not significant.

The wilderness experience would be adversely affected by the short-term presence of heavy equipment and temporary structures. In addition, proposed wilderness in a 3.65-mile section of beach face would be trammeled due to the active, mechanized deposition of dredged sediment. Similarly, the proposed wilderness would lose some of its natural character under this alternative due to active manipulation of the beach front along a 3.65-mile section of beach. On the other hand, the proposed wilderness at Shackleford banks would remain undeveloped because no permanent structures would be built. Furthermore, the periodic deposition of sediment would prevent the loss of additional habitat at Shackleford Banks and restore habitat for certain biota. In that regard, NPS policy provides that management intervention may be undertaken to the extent necessary to “correct past mistakes, the impacts of human use, and influences originating outside of wilderness boundaries” (NPS *Management Policies* (2006) Section 6.3.7). Additionally, the National Park Service, Cape Lookout National

Seashore has completed a Wilderness Minimum Requirement Analysis (MRA) (Appendix L) for the disposal of dredged material on Shackleford Banks. On balance, the overall impact of the DMMP on wilderness character would be beneficial by forestalling or minimizing future loss of the wilderness resource itself. The adverse impacts noted above would be temporary and cyclical, while the beneficial impacts would be more long-term.

No Action Alternative. Under the No Action alternative, dredged material would not be disposed on Shackleford Banks. As a result, no actions affecting wilderness character would take place in wilderness and there would be no immediate impacts to wilderness character. However, human-exacerbated erosion would continue to occur, resulting in additional loss of the wilderness resource.

5.18 Visitor Use and Experience

Proposed DMMP. Expansion of the beach at Shackleford Banks would improve the visitor experience for individuals visiting this part of Cape Lookout National Seashore. In particular, beach expansion would offset potential future beach loss due to erosion, create or help maintain valuable wildlife habitat, and otherwise sustain and improve recreational opportunities for beach users. Beach expansion would also help prevent future loss of the wilderness resource and attendant opportunities for solitude and unconfined recreation. Some impacts to visitor use and experience would be adverse, but short-term. For example, the visitor experience at Shackleford Banks beaches would be temporarily impacted by the noise and visual intrusion of the dredge and associated pipes and equipment during disposal of dredged material on the beach. Within the sediment placement area off Shackleford Banks, boat and human traffic access would be restricted for safety reasons during placement activities. However, since all work at Shackleford would take place during the off season (November 16 to March 31) and relatively small area of beach would be impacted each day (up to a maximum of 200 feet), impacts would be temporary and not significant.

No Action Alternative. Under this alternative, no sediment would be disposed at Shackleford Banks. Anthropogenically-enhanced erosion would continue to occur, with corresponding losses to wildlife habitat, the wilderness resource, and beach-related recreational activities. Impacts to visitor use and experience would be adverse and significant over the long term.

5.19 Park Operation

Proposed DMMP. This alternative would entail a commitment of NPS personnel to monitor the disposal of sediment at the beach, educate the visiting public about the sediment disposal operation, and ensure visitor safety while disposal activities were taking place. The proposed action would thus entail additional workload for the Seashore’s resource management, interpretive, and law enforcement staff. Given that the proposed work would be relatively small-scale and conducted at 3-year intervals, impacts to park operations would not be significant, despite being somewhat adverse.

No Action Alternative. Under this alternative, the sediment would not be disposed on Shackleford Banks, therefore, park operations would not be affected.

5.20 Cumulative Effects

The Council on Environmental Quality (CEQ) defines cumulative impact as:

*The impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (*40 CFR 1508.7). This analysis follows the 11-step process outlined by the Council on Environmental Quality (CEQ) in their 1997 publication Considering Cumulative Effects Under the National Environmental Policy Act (Appendix K).

Proposed DMMP. The detailed analysis of cumulative effects is included in Appendix K. The assessment of cumulative effects focused on effects of the following: 1) the proposed future expansion of the Port of Morehead City on Radio Island; 2) continued maintenance dredging within the existing federal navigation channels; 3) effects of placing maintenance sediment in the nearshore area; and 4) effects of placing sediment on the beaches of Bogue and Shackleford Banks on significant coastal shoreline resources.

1. Proposed Port Expansion on Radio Island. The NC State Port Authority (NCSPA) is pursuing port industrial development on Radio Island and has completed the NEPA document for this action (NCSPA 2001). Currently, NCSPA has not obtained the necessary authorizations from the Regulatory Division, Wilmington District, USACE (i.e., Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act permits) and the State of North Carolina to complete this activity. Moreover, funding for the proposed port expansion has not been approved by the North Carolina State Legislature and no new or existing customer of the port facility has requested to fund this proposed action.

At this time, the USACE does not know when or if this expansion project will be completed. Nor does the USACE know the specific disposal locations of the approximately 1.7 million cubic yards of dredged material and/or the maintenance interval of the expanded Harbor channels. Discussions with representatives from the NCSPA (Personnel Communication, Mr. Todd Walton, Environmental Supervisor, NCSPA, October 19, 2011) indicate that NCSPA are still interested in pursuing this action but they don't know when or if this will occur.

2. Effects of Continued Maintenance Dredging in the Morehead City Harbor. Benthic organisms within the defined federal navigation channels would be lost. The benthic organisms found in the areas adjacent to the federal navigation channels would not be impacted and would provide benthic populations for recolonization. However, these federal channels have been maintained for many years. Construction of Morehead City Harbor was authorized in 1910 and over the years the entrance and Inner Harbor channels have been widened and deepened to their present width and depth. The proposed DMMP will continue maintenance of the existing Harbor channels with no deepening or widening proposed for the next 20 years. Maintenance dredging of the existing federal navigation channels would continue to be accomplished by pipeline, hopper and/or bucket and barge would not cause any long term impacts in the project area. The proposed DMMP would not cause any adverse cumulative impacts.

3. Effects of Maintenance Sediment Placed in the Nearshore Area. Figures 3-22 and 3-23 show the proposed nearshore placement areas for the DMMP, which include the following: 1) An additional 1,209 acres of nearshore placement area off Bogue Banks (total of 559 acres existing plus 1,209 or 1,768 acres); and 2) New 492 acres of nearshore placement area off Shackleford Banks. A total of about 1,701 acres of new nearshore area off Bogue and Shackleford Banks would be impacted by the proposed DMMP. Both nearshore areas off Bogue and Shackleford Banks are located within the littoral zone and any sediment placed in these areas would reduce or minimize any future deflation of the Beaufort Inlet Ebb Tide Delta (discussed in Section 3.2.4 Ebb Tide Delta).

The USACE believes that placement predominantly sandy material (80% or greater sand) from the Inner Harbor within the nearshore areas off Bogue and Shackleford Banks will not cause any significant environmental adverse impacts since the existing substrate in the nearshore areas off Bogue and Shackleford Banks are similar to the maintenance sediment that will be disposed of in these areas. No significant increase in turbidity is expected since these nearshore sites are located within the surf zone. Additionally, no hardbottoms would be adversely impacted by the placement of sediment in these nearshore areas. No maintenance sediment would be lost to the system by placing it in the ODMDS. The following benefits would accrue: 1. Reduce or minimize the deflation of the Beaufort Ebb Tide Delta, 2. Increase the amount of coarse-grained sand migrating to the ocean beaches while the fine-grained material should migrate offshore, and 3. Provide additional habitat for infauna species.

No adverse cumulative impacts are anticipated for the proposed DMMP. Sediment placement activities on the existing nearshore area off Bogue Banks have occurred many times over the years. The USACE believes that placement of sediment in nearshore areas of Bogue and Shackleford Banks will slow or minimize the continued deflation of the Ebb Tide Delta and ameliorate erosion of the adjacent beaches.

4. Effects of Maintenance Dredged Sediment Disposed on the beaches of Bogue and Shackleford Banks. The DMMP may place suitable sediment (90% or greater sand) on up to 10.5 miles of beach from Fort Macon State Park to about Pine Knoll Shores (Figure 3-9) on Bogue Banks. Figure 3-10 shows the proposed 3.65 mile beach disposal area on Shackleford Banks. The proposed DMMP plans to place suitable sediment on the beaches of Bogue and Shackleford Banks once every three years.

There are two reasonably foreseeable projects on Bogue Banks and these are; the Bogue Banks Coastal Storm Damage Reduction (CSDR) Project and any private beach nourishment projects. Both of these reasonably foreseeable projects on Bogue Banks would continue to place beach quality sediment on the same beaches that have been previously nourished. No new beach disposal areas on Bogue Banks will be impacted by the proposed DMMP.

Relatively small portions of North Carolina beaches are presently affected by the beach disposal or placement of sand from maintenance activities, about 6%. With the proposed DMMP, the impact area would not increase on Bogue Banks since all beach disposal areas proposed have been previously impacted by projects undertaken by both the USACE and Carteret County. The proposed new 3.65 mile sediment disposal area on Shackleford Banks would result in an increase of 1.1% of the federally authorized beach disposal areas in North Carolina. On a statewide scale the existing and approved disposal sites are well distributed in northern central and southern parts of the state with undeveloped protected beaches (i.e., National/federal and State Parks and Estuarine Reserves) in between. It is unlikely that cumulative impacts from space crowded perturbation are occurring or will occur due to the implementation of this DMMP. The analysis suggests that the potential impact area from the proposed and existing actions is small relative to the area of available similar habitat on a vicinity and statewide basis. These areas are expected to recover food resources, which should continue to be available. It is expected that the risk that the direct and cumulative impacts of the proposed action and other existing similar activities, would reach a threshold with high potential for population level impacts on important commercial fish stocks and birds is low.

No adverse cumulative impacts are anticipated for the proposed DMMP. Sediment disposal activities on the beaches of Bogue Banks have occurred many times over the years. The USACE also believes that disposal of sediment on the beaches of Bogue and Shackleford Banks will slow or minimize the continued deflation of the Beaufort Ebb Tide Delta and reduce future erosion.

No Action Alternative. The dredged material disposal for the No Action alternative is:

- Inner Harbor material would be disposed of in Brandt Island or the ODMDS.
- Outer Harbor coarse-grained material would be disposed of on the beaches of Fort Macon State Park and Atlantic Beach and/or placed in the existing Western nearshore placement (Ebb Tide Delta) area off Bogue Banks.
- Outer Harbor Entrance channel material would be disposed of in the ODMDS.

The beach disposal areas from Fort Macon State Park to the Town of Atlantic Beach have occurred many times over the years. Both the USACE and Carteret County have placed suitable sediment in these beach areas. The IOP does not include the disposal of dredged material on Shackleford Banks.

No adverse cumulative impacts are anticipated as a result of implementation of the No Action alternative on Bogue Banks. However, the No Action alternative will not place sediment on Shackleford Banks or in the nearshore area to the east of Beaufort Inlet, which may result in the continued the long-term erosion of the island and deflation of the eastern side of the Beaufort Inlet Ebb Tide Delta.

6 STATUS OF ENVIRONMENTAL COMPLIANCE ACTIONS FOR THE PROPOSED DMMP, COORDINATION AND DOCUMENTATION

The following section briefly discusses the status of the environmental compliance, coordination and documentation for the proposed DMMP.

As stated in previous sections, the sediment disposal for the proposed DMMP is: Fine-grained material from the Inner Harbor will be disposed in Brandt Island and/or the ODMDS. Predominantly sandy material from the Inner Harbor may be placed in either the proposed Nearshore West and East or in Brandt Island; coarse-grained material from the Outer Harbor will be placed either in the expanded Nearshore West and East (with minor amounts going to the ODMDS during inclement weather) or on the beaches of Bogue and Shackleford Banks; and Outer Harbor Entrance channel material will be disposed in ODMDS.

6.1 Water Quality (including Section 401 Certification)

A Section 404(b)(1) evaluation will be required for the return of effluent discharged from Brandt Island and the proposed disposal of maintenance dredged material on the beaches Bogue and Shackleford Banks and in the nearshore placement areas. The Section 404(b)(1) evaluation that addresses these discharges is found in Appendix H.

Return of effluent from Brandt Island can be controlled such that water released from the diked area has little or no suspended solids. Proper management of releases from Brandt Island will not result in turbidity levels above 25 NTUs in the area of the spillway pipe outfall.

On March 19, 2012, the NCDWQ re-issued 401 general water quality certifications that cover the following dredged material disposal options: beach disposal on Bogue and Shackleford Banks (NCDWQ Certificate # 3908), nearshore sediment disposal off Bogue and Shackleford Banks (NCDWQ Certificate # 3908), and upland diked disposal activities on Brandt Island (NCDWQ Certificate # 3888). Copies of these general water quality certificates are found in Appendix D. All conditions and requirements of the water quality certifications will be adhered to in the implementation of the proposed DMMP.

6.2 Ocean Dumping

The proposed DMMP will continue to use the EPA designated Morehead City ODMDS. The dredged material proposed for ocean disposal has previously been evaluated for compliance with EPA's Ocean Dumping Regulations and Criteria and are, therefore, not considered significantly contaminated and are acceptable for transportation for ocean dumping under Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972, as amended. The USEPA, Region 4 has concurred with all previous Section 103 evaluations. Periodic re-evaluations will be performed as required by EPA and USACE policy.

All disposal activities at the Morehead City Ocean Dredged Material Disposal Site (ODMDS) must be conducted in accordance with the Site Management and Monitoring Plan (SMMP), dated February 2010 (USEPA and USACE, 2010). All Section 103 ocean disposal permits or concurrences shall be conditioned as necessary to assure consistency with the SMMP dated February 2010.

6.3 US Fish and Wildlife Coordination Act

Since the Morehead City Harbor DMMP is strictly for the disposal of maintenance dredged material from an existing navigation channel, a formal Draft and Final Coordination Act Report is not required from USFWS. However, the USACE has prepared and will coordinate a Biological Assessment (Appendix J) with USFWS and the NMFS regarding project impacts to threatened and endangered (T&E) plants and animals and their habitats pursuant to the Endangered Species Act (ESA) of 1973, as amended. Moreover USFWS is an active member of the PDT and will remain so throughout the NEPA process.

6.4 Endangered and Threatened Species (includes State Protected Species)

A biological assessment (Appendix J) evaluating the potential impacts of the proposed action on endangered and threatened species has been prepared and will be coordinated with the USFWS (jurisdiction over the Florida manatee, Piping Plover and its designated critical wintering habitat, nesting sea turtles, and seabeach amaranth) and NMFS (jurisdiction over other protected marine and aquatic species which may occur in the project vicinity) pursuant to Section 7 of the Endangered Species Act of 1973 (PL 93-205), as amended. Compliance obligations under Section 7 will be satisfied prior to implementation of the proposed action.

In the Morehead City Harbor, hopper dredging takes place only from January 1 to March 31 of any year and complies with the terms and conditions of the Regional Biological Opinion on hopper dredging by NOAA Fisheries, dated September 25, 1997 (NMFS 1997). The NMFS Biological Opinion dated September 25, 1997 authorizes the continued hopper dredging of channels and borrow areas in the Southeastern United States.

On 18 September 2008, the USACE provided NMFS with a revised Draft South Atlantic Regional Biological Assessment (SARBA). The USACE' SARBA would authorize the following activities: "*Dredging activities in the coastal waters, navigation channels (including designated Ocean Dredged Material Disposal Sites (ODMDS), and sand* *mining areas in the South Atlantic Ocean from North Carolina/Virginia Border through and including Key West, Florida and the Islands of Puerto Rico and the U.S. Virgin Islands (USVI)*". Once NMFS provides the USACE with their Biological Opinion, any new conditions or restrictions would supersede the NMFS Biological Opinion dated September 25, 1997. Hopper dredging within the Morehead City Harbor would comply with any new conditions and/or restrictions found within the new NMFS BO.

The State Protected Species found in Table 4-9 will not be adversely affected by any component of the DMMP.

6.5 Essential Fish Habitat

Coordination required by the 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA (PL 94-265)) will be completed through the NEPA process, prior to implementation of the DMMP.

6.6 Executive Order 11593 (Protection and Enhancement of the Cultural Environment)

Pursuant to 36 CFR Section 800.4, the Wilmington District has completed a cultural resources and hard bottom remote sensing survey over the DMMP project areas. In addition, Intersal Corporation is conducting research in much of the same area under North Carolina exploratory permits. The placement area is considered sensitive due to known resources, particularly *Queen Anne's Revenge,* listed in the National Register of Historic Places, and sites such as the *USS Quinnabaugh*, the *L. A. Bailey*, and the *Parkins*. In addition, several privately funded research efforts have been conducted, and the location data will be shared with the USACE and documented in the recently completed remote sensing surveys. One of these private surveys identified 214 magnetic/sonar targets in and around the western project area. Of these, 26 were found to be items of interest for further investigation (old stock anchors, cannon, ship fittings).

The most recent private research is being conducted pursuant to a State permit issued to Intersal Corporation for further exploration within and adjacent to the proposed placement areas. Intersal's detailed survey and site investigations are still in progress, and will be integrated with the recent research conducted by Tidewater Atlantic Research for the Wilmington District. The Tidewater Atlantic research, conducted at a Phase I level, has identified up to 193 sonar and/or magnetic targets that may be associated with historic shipwrecks or navigation debris.

Consultation has been initiated with the NC SHPO through the state's Underwater Archaeology Branch (UAB). Intersal is also considered a consulting party under terms of Section 106 NHPA, per 36 CFR Part 800. Although the UAB acknowledges that deposition may preserve shipwreck remains, any mounding or introduction of contaminated sediments may adversely affect shipwreck remains by altering natural deposition and thereby causing erosion. In order for the State to fully concur with a no adverse effect determination, the USACE will have to agree to specifying placement methods in the construction contract that ensure material is equally distributed throughout the designated placement areas. In addition, the Wilmington District and the State must enter into a cooperative program to regularly share GIS data so that sediment deposition and transport can be monitored. This will entail meetings between UAB, Wilmington District, and possibly contractor GIS experts so that available data can be discussed, evaluated, and program success measured.

Per 36 CFR Section 800.5, a No Adverse Effect determination may be obtained once an agreement is reached on placement method and monitoring.

Prior to any disposal of dredged material on Shackleford Banks, the USACE will walk the staging, construction corridor (between the toe of dune to the MLW contour) and the 3.65 mile disposal area to ensure that no archaeological sites would be adversely impacted by the proposed action.

If a pipeline dredge is used for direct placement in the nearshore placement areas, a spill barge would need to be anchored within the nearshore areas to direct the discharge of sediment from the pipeline dredge. In order to avoid adverse impacts to cultural resources, both the pipeline route (from the dredge to the nearshore area) and the location of the spill barge anchoring area would be coordinated with the NC State Historic Preservation Office (SHPO) and UAU.

6.7 Executive Order 11988 (Floodplain Management)

Dredged material would be placed in the floodplain adjacent to the Bogue and Shackleford Banks beaches. The proposed action is not anticipated to induce development of the floodplain, or to otherwise adversely affect any floodplain, since the existing oceanfront property is developed. The proposed action is in compliance with the requirements of Executive Order 11988.

No practical alternative exists to locating components of the proposed project in the floodplain. Every effort will be taken to minimize potential effects within the flood plain. The action is in compliance with State/local floodplain protection standards.

6.8 Executive Order 11990 (Protection of Wetlands)

Implementation of the DMMP will not require filling any wetlands on Brandt Island and/or the beaches of Bogue Banks (Fort Macon State Park, Atlantic Beach, and Pine Knoll Shores). Additionally, the proposed work will not produce any significant hydrologic or salinity changes affecting any wetlands. The proposed action is in compliance with Executive Order 11990.

Additionally, implementation of the DMMP would not adversely impact benthic resources (Sections 5.5.2 and 5.5.3 Benthic Resources – Beach and Surf Zone and Nearshore Ocean), sediment composition, including grain size, and color (Section 5.1.2

Sediment Characteristics), and recovery times of organisms (Sections 5.5.2 and 5.5.3 Benthic Resources – Beach and Surf Zone and Nearshore Ocean).

Exemption from NPS Wetland Statement of Findings. Executive Order 11990 – *Protection of Wetlands*, directs all federal agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative. In the absence of such alternatives, parks must modify actions to preserve and enhance wetland values and minimize degradation. Consistent with Executive Order 11990 and NPS Director's Order #77-1: *Wetland Protection*, NPS adopted a goal of "no net loss of wetlands." Director's Order #77-1 states that for new actions where impacts to wetlands cannot be avoided, proposals must include plans for compensatory mitigation that restores wetlands on NPS lands, at a minimum acreage ratio of 1:1.

For the purpose of implementing EO 11990 on NPS-managed lands, any area that is classified as a *wetland* according to the U.S. Fish and Wildlife Service's "Classification of Wetlands and Deepwater Habitats of the United States" (Report FWS/OBS-79/31); Cowardin et al. 1979) is subject to NPS D.O. #77-1 and its implementation procedures. Under the Cowardin definition, a wetland must have one or more of the following three attributes:

1. at least periodically, the land supports predominantly hydrophytes (wetland vegetation);
2. the substrate is predominantly undrained hydric soil; or
3. the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year.

The Cowardin wetland definition encompasses more aquatic habitat types than the definition and delineation manual used by the Corps of Engineers for identifying wetlands under Section 404 of the Clean Water Act. The 1987 "Corps of Engineers Wetlands Delineation Manual" and its regional supplements require that *all three* of the parameters listed above (hydrophytic vegetation, hydric soil, wetland hydrology) be present in order for an area to be considered a wetland. The Cowardin wetland definition includes such wetlands, but also adds some areas that, though lacking vegetation and/or soils due to natural physical or chemical factors such as wave action or high salinity, are still saturated or shallow inundated environments that support aquatic life (e.g., intertidal portions of shorelines that are unvegetated due to wave action).

Figure 6-1 shows the amount of existing intertidal Cowardin "wetlands" in the 3.65 mile disposal area on Shackleford Banks. These intertidal wetlands were delineated using the Cowardin wetland definition and classification system (see item 3 mentioned above). The non-vegetated tidal wetlands are located between the Mean Higher High Water and Mean Lower Low Water contours on the ocean beach.

Intertidal unvegetated beach wetlands will be replaced with an unvegetated intertidal beach community. Please note the dredged material disposal interval on Shackleford Banks is every three years. Additionally, at any one time up to 2 miles of the 3.65 mile long disposal area on Shackleford Banks will be used. However, over the next twenty years it is expected that portions of the entire 3.65 mile long disposal area will be used. Assuming that the entire 3.65 miles long disposal area is used over the next 20 years, a maximum of about 27.5 acres of Cowardin "wetlands" will be filled as part of the DMMP.

The beach profile cross sections shown in Figure 6-2 displays the cross sectional length of the wetland zone for a typical profile within the Shackleford Banks disposal area. The blue line represents the pre-project typical beach condition while the red line represents the post-project evolved profile condition. The width of the defined wetland along the beach face is defined between the mean higher high water and mean lower low water contours. Figure 6-2 shows that disposal of compatible sediment along the beach face does not measurably change the width of the beach used to define the wetland area, rather this section of the beach is translated seaward the distance of the fill. Therefore, this means that the 27.5 acres filled within the 3.65 miles of placement area on Shackleford Banks would result in the restoration of the same amount or about 27.5 acres of Cowardin "wetlands".

This meets the NPS "no-net-loss of wetlands" policy as stated in the NPS Procedural Manual #77-1. Intertidal areas that are exposed by the extreme low spring tide are considered wetlands. Since there will be a "no-net-loss of wetlands" to wetland habitat as a result of the proposed action, the DMMP project can be considered under the Restoration Exception in Section 4.2.1 (h) of NPS Procedural Manual #77-1. Sand grain size from the proposed donor dredge site is similar, or the same, as what is currently found in the beach intertidal zone. Temporary impacts to the existing wetlands will be unavoidable as this area will be replaced with sands to create a new beach intertidal area immediately to the south of the existing shoreline, but curvilinear enough to create the same shoreline farther offshore. It is anticipated that the natural ecological processes will, to the extent practicable, function at the site as they did prior to disturbance. This includes the re-establishment of the benthic community. Therefore, under the restoration excepted action a Wetland Statement of Findings does not need to be prepared.

The following BMP's will be observed:

1. Finished shoreline will have a similar slope as the existing shoreline.
2. Use of heavy equipment for smoothing of sand will leave no trace of disturbance when the disposal effort is complete.

Figure 6-1. The Extent of Cowardin "wetlands" (in red) within the 3.65 Mile Disposal Area on Shackleford Banks. The Area in Red is measured from the Mean Higher High Water and Mean Lower Low Water contours on the ocean beach and is about 27.5 acres.

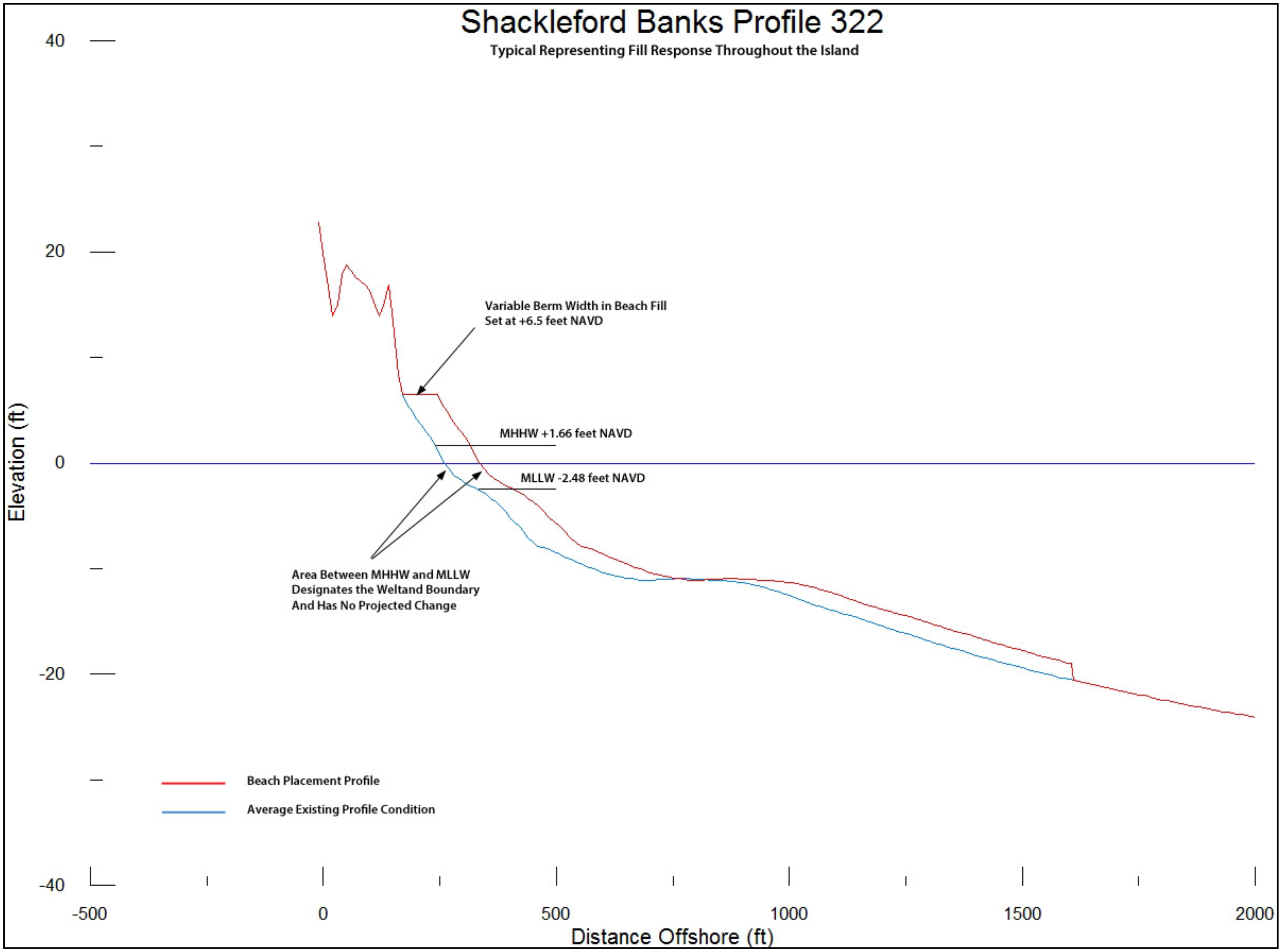


Figure 6-2. Typical Beach Profile Within the 3.65 mile Long Shackleford Banks Beach disposal Area.

6.9 Executive Order 13186 (Protection of Migratory Birds)

This Executive Order mandates agencies to protect and conserve migratory birds and their habitats pursuant to the Migratory Bird Treaty Act of 1918, as amended.

Migratory shorebirds are found along the beaches of Bogue and Shackleford Banks and use these areas for foraging and roosting habitat. The proposed action would restore and increase the habitat along Bogue Banks and Shackleford Banks for migratory birds.

Migratory birds may also use Brandt Island for foraging, nesting, and roosting habitat within the migratory bird nesting season from April 1 to August 31 of any year. However, as previously discussed, the NC Wildlife Resources Commission indicates they consider Brandt Island as low quality migratory bird If any work is initiated on Brandt Island within the migratory bird nesting season (April 1 to August 31), USACE will coordinate with representatives from the NC Wildlife Resources Commission to ensure that migratory bird nesting is not adversely impacted. Implementation of the DMMP will have no adverse effect on migratory shorebirds and therefore would comply with EO 13186.

6.10 Executive Order 12898 (Environmental Justice)

Executive Order 12898 states that the federal government would review the effects of its proposed actions on low income communities. Federal agencies are "to the greatest extent practicable and permitted by law" identify and address "as appropriate, disproportionately high and adverse human health and environmental effects of its programs, policies and activities on minority populations and low-income populations in the United States."

Minority and Low Income Populations. In 2010, Carteret County was racially composed of 90.1%t White, 7.4% Black, 2.5% Hispanic, 0.5% American Indian, 0.7% Asian, and 0.1% Native Hawaiian or Pacific Islander, and about 1.1% of the population identify with two or more races (US Census 2010). Please note, the total racial percent of the population may be greater than 100% because Hispanic may be identified in more than one group.

Any individual with total income less than an amount deemed to be sufficient to purchase basic needs of food, shelter, clothing, and other essential goods and services is classified as poor. The amount of income necessary to purchase these basic needs is the poverty line or threshold and is set by the Office of Management and Budget (US Census 2010). The 2010 poverty line for an individual under 65 years of age was $11,161. The poverty line for a three-person family with one child and two adults was $17,268. For a family with two adults and three children, the poverty line was $25,603 (US Census 2010).

Carteret County per capita income for 2010 was $26,501 and the median household income for 2010 was $49,711. In 2010, in North Carolina the per capita income was

$35,249 and the median household income was $44,357. In 2010 the poverty rate in Carteret County was around 11.8%, and for children ages 0-17 the poverty rate increased to 18.9%. In 2010 the property rate in North Carolina was 16.2% and for children ages 0 to 17 the poverty rate was 22.5% (US Census 2010).

Figures 6-3 and 6-4, below show the minority/low-income populations and low-income communities in the project area which is taken from the 2010 US Census data.

The proposed action would impact the following areas: federal navigation channels in Morehead City Harbor, Brandt Island, Bogue and Shackleford Banks beaches, nearshore areas off Bogue and Shackleford Banks, and the ODMDS.

The USACE evaluated potential project impacts of the proposed long-term Harbor maintenance and found that the information shows that the proposed action would not cause disproportionately high and adverse impacts on minority populations or low-income populations. No impacts to either minority/low-income populations or low-income communities are anticipated as a result of the Proposed Action therefore the action would comply with EO 12898.

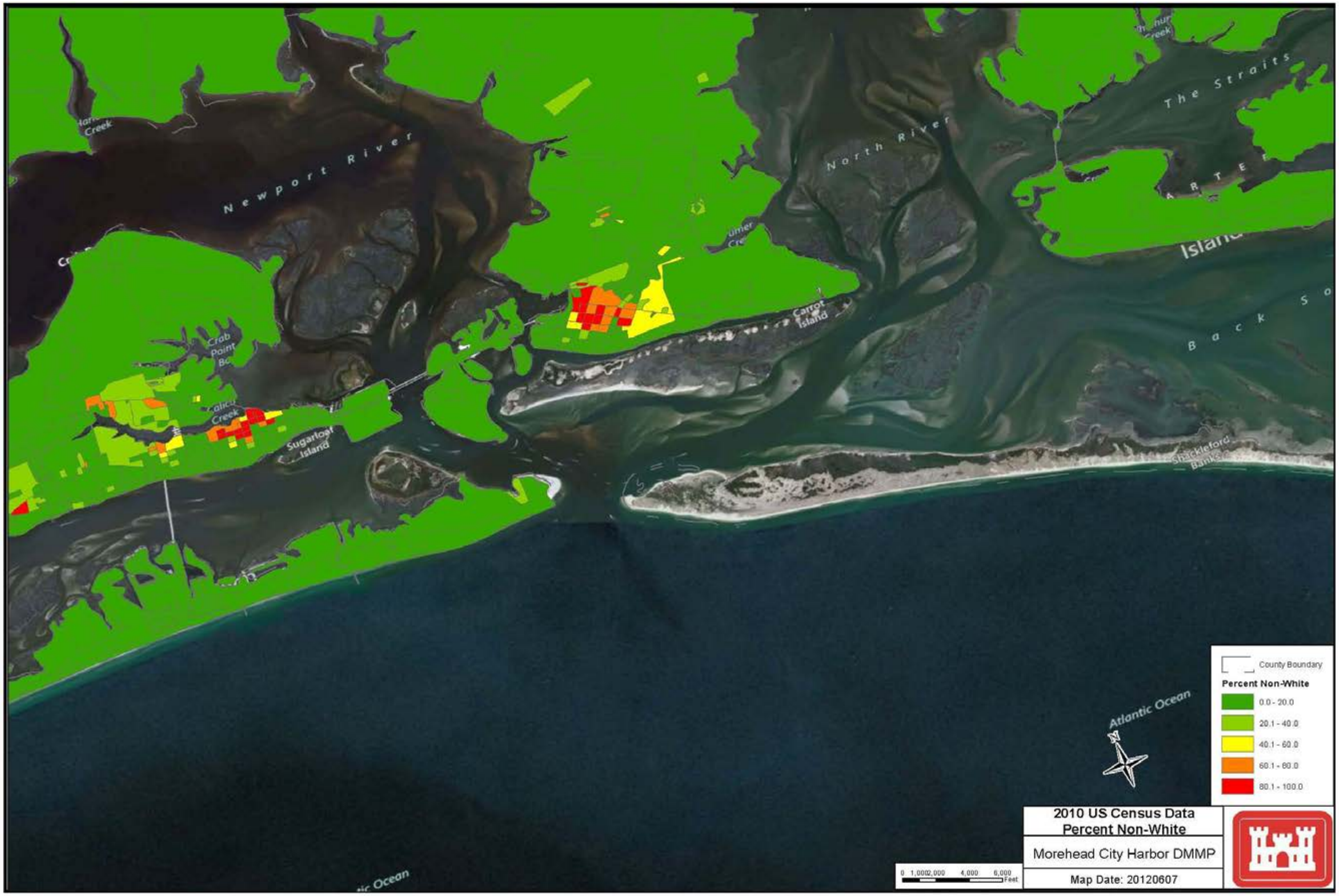


Figure 6-3. Minority Populations in the Project Area **(**US Census 2010)

Figure 6-4. Percent of Population Below Poverty Level (US Census 2010)

6.11 Executive Order 13045 (Protection of Children from Environmental Health and Safety Risks)

Executive Order 13045 states that the Federal government would review the effects of its proposed actions on children because they may suffer disproportionately from environmental health risks and safety risks. Federal agencies are to "identify and assess environmental health risks and safety risks that may disproportionately affect children;" and "ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks."

In Carteret County, persons under 18 years old make up about 19.2% of the population or about 12,762. Student enrollment for the 2010-2011 school year was about 8,550 in pre-kindergarten through 12th grade. There are eight elementary, four middle, and three high schools in Carteret County (US Census 2010).

In 2011, Carteret County managed 14 parks and 3 County school ball fields, ranging in size from 1 to 31 acres, located from Sea Level to Cedar Point, totaling approximately 200 acres (Carteret County Parks and Recreation Department 2011). Carteret General Hospital in Morehead City is the only hospital in Carteret County.

Figure 6-5, below shows the locations of parks, schools, and hospitals, within the project area where the majority of the construction would occur. These facilities are dispersed throughout the community and are not located disproportionately near the project area.

The work zone within the disposal area on the beaches of Shackleford and Bogue Banks will be fenced and the contractor will supervise all access to the construction site. Additionally, all work on these beaches will take place predominantly during the winter months of any year and the likelihood of children in the construction area is slight. No impacts to children are anticipated as a result of the proposed action.

Figure 6-5. Location of Hospital, Parks, and Schools in the Project Area.

6.12 North Carolina Coastal Zone Management Program

The proposed DMMP complies with the enforceable policies of North Carolina's approved coastal management program and will be conducted to the maximum extent practicable in a manner consistent with the program and any received authorizations. The paragraphs which follow support this determination.

Once the Final Environmental Impact Statement (FEIS) for the DMMP has been completed, the USACE will submit a separate consistency determination to the NC Division of Coastal Management in accordance with Section 307 (c) (l) of the Federal Coastal Zone Management Act of 1972, as amended.

The actions addressed in the DMMP will take place in the designated coastal zone of the State of North Carolina. Pursuant to the Federal Coastal Zone Management Act (CZMA) of 1972, as amended (P.L. 92-583), federal activities are required to be consistent to the maximum extent practicable with the federally approved coastal management program of the state in which their activities would be occurring.

Section 1102 (a) states that "clean, beach quality material from navigation channels within the active nearshore, beach, or inlet shoal systems must not be removed permanently from the active nearshore, beach or inlet shoal system unless no practicable alternative exists. Preferably, this dredged material will be disposed of on the ocean beach or shallow active nearshore area where environmentally acceptable and compatible with other uses of the beach." When considering a project's compliance with Section 1102, NCDCM has stated that the section should be read in concert with NCAC 7H.0208 (2)(G), which does provide some flexibility for publicly funded projects, allowing them to be considered by review agencies on a case by case basis with respect to dredged material disposal.

As outlined in the DMMP and its alternatives analysis, the majority of the clean, beach quality material (i.e., 90% or greater sand) removed from the Harbor will be disposed of on the Bogue and Shackleford Banks beaches, as well as the proposed Nearshore Placement Areas.

The disposal of dredged material on the ocean beach of Bogue Banks from Atlantic Beach to Pine Knoll Shores is consistent with the North Carolina Coastal Management Program. State concurrence with disposal of suitable maintenance dredged material (≥90% sand) from maintenance dredging of the Harbor navigation channels on Bogue Banks was obtained for the Section 933 in 2003.

The existing Western Nearshore Area off Bogue Banks was previously found to be consistent with the NC Coastal Management Program (NCCMP) in 1994 (CD94-29). Further study of the Nearshore Area, both by the USACE and other entities, solidifies the USACE' belief that this disposal area is within the "active nearshore area" as outlined in section 1102(a). Specifically, recent analysis of the ebb-tide delta area of Beaufort Inlet indicates that material placed within the nearshore placement area appears to be diffusing and partially moving toward the northeast. This movement of material farther into the littoral complex is helping to reduce the deflation rate of the ebb-tide delta. Significantly, the USACE notes that there is no indication from the analysis of the available survey data that material is moving out of the nearshore area toward deeper water. The expansion of this nearshore area into shallower water closer to the shore should serve to hasten the movement of material into the center of the ebb-tide delta. Evidence suggests that material placed in the existing Nearshore Placement Area appears to be moving toward the mouth of the inlet, and not moving into deeper water, and that littoral currents are operating on this material, and are moving this material farther into the shallow nearshore area. This data further reinforces the USACE position that the nearshore placement area is indeed within the shallow active nearshore area described in Section 1102.

The Morehead City Harbor DMMP is also proposing to place suitable maintenance dredged material (≥ 90% sand) from maintenance dredging of the Harbor on Shackleford Banks. Shackleford Banks is within the Cape Lookout National Seashore and is under the jurisdiction of the National Park Service (NPS). The NPS has requested that the USACE consider disposal of suitable maintenance dredged material on Shackleford Banks in order to reduce long-term erosion of this island. The USACE believes that this activity would also be consistent with the North Carolina Coastal Management Program.

In the past, when conditions were unsafe for navigation in the nearshore area, the dredging contractor had the option to take the dredged material to the ODMDS. Future contracts may not include the option to take this material to the ODMDS as long as this practice does not become cost prohibitive to implement.

In the case that this practice becomes cost prohibitive, the Wilmington District may allow dredge captains the discretion to place dredged material in the ODMDS when those captains believe that sea and weather conditions prohibit safe operation within the nearshore areas off Bogue and Shackleford Banks. Disposal of some beach quality material in the ODMDS when safety factors require has been the only circumstance where beach-quality material from the Harbor has been disposed of outside the active nearshore or beach system. While the USACE will continue to minimize disposal of material in the ODMDS as much as possible, the narrow dredging window (usually 90 days between January-March) often requires that dredge vessels work in adverse weather and seas and place some material in the ODMDS, in order to accomplish all dredging work within the short timeframes required.

Beach-quality material disposed of in the ODMDS is not being removed from the system permanently, and this action is therefore consistent with Section 1102. Beach-quality material is disposed of in certain designated areas within the ODMDS, so that it may be retrieved at a later date for beach disposal. On two occasions, in 2004 and 2007, local governments have used the ODMDS as a borrow source for disposal of beach-quality material onto the beaches of Bogue Banks. In the past six years, the USACE estimates that more material has been removed from the ODMDS and disposed of on the beach (roughly 1.5 million cubic yards) than has been disposed of in the ODMDS by dredging activities (roughly 1.3 million cubic yards). Further, both the USACE (in its Bogue Banks hurricane and storm damage reduction study and Carteret County (in its April 15, 2009 Request for Qualifications (RFQ) for a Master Beach Nourishment Plan) have identified the ODMDS as a primary source of borrow material for beach nourishment activities over the next thirty to fifty years. Specifically, Carteret County indicates that among potential borrow sites, "the ODMDS is preferable for many reasons." In short, it has recently become clear that material disposed of in the ODMDS, and segregated in the area for beach-quality material, is not being permanently lost to the system. As such, the current and future use of the ODMDS is fully consistent with Section 1102, although it will continue to limit disposal of beach-quality material into the ODMDS to that required for safety of vessels and crew.

6.12.1 Areas of Environmental Concern (AECs)

The proposed action would take place in areas designated under the NC Coastal Management Program as AECs (15A NCAC 7H .0100). Specifically, the activities will occur in three AECs, Estuarine Waters, Ocean Hazard, and Public Trust Area. The following determination has been made regarding the consistency of the proposed action with the State's management objective for the AECs that may be affected:

<u>Estuarine Waters</u>. Estuarine Waters are the state's oceans, sounds, tidal rivers and their tributaries, which stretch across coastal North Carolina and link to the other parts of the estuarine system: public trust areas, coastal wetlands and coastal shorelines. For regulatory purposes, the inland, or upstream, boundary of estuarine waters is the same line used to separate the jurisdictions of the Division of Marine Fisheries and the NC Wildlife Resources Commission. However, many of the fish and shellfish that spend part of their lives in estuaries move between the "official" estuarine and inland waters.

The proposed project would not adversely impact estuarine waters, since all dredging will take place within the existing Morehead City Inner Harbor channels and Brandt Island. On average, maintenance of these Inner Harbor channels take place every two years.

<u>Ocean Hazard</u>. The Ocean Hazard System is made up of oceanfront lands and the inlets that connect the ocean to the sounds. The beach disposal areas off Bogue and Shackleford Banks are within the designated Ocean Hazard System. The Coastal Resources Commission has designated three-ocean hazard AECs.

1. The Ocean Erodible AEC covers North Carolina's beaches and any other oceanfront lands that are subject to long-term erosion and significant shoreline changes. The seaward boundary of this AEC is the mean low water line. The landward limit of the AEC is measured from the first line of stable natural vegetation and is determined by adding: a distance equal to 60 times the long-term, average annual erosion rate for that stretch of shoreline to the distance of erosion expected during a major storm. The width of the AEC varies from about 145 feet to more than 700 feet.

2. The High Hazard Flood AEC covers land subject to flooding, high waves and heavy water currents during a major storm. These are the lands identified as coastal flood with velocity hazard, or "V zones," on flood insurance rate maps prepared by the Federal Insurance Administration. "V zones" are determined by an engineering analysis of expected flood levels during a storm, expected wave and current patterns, and the existing topography of the land. The high hazard flood AEC often overlaps with the ocean erodible and inlet hazard AECs.

3. Unvegetated Beach Area AEC where no stable natural vegetation is present may be designated as an unvegetated beach area on either a permanent or temporary basis.

The proposed action would not adversely affect oceanfront lands and inlets on Bogue Banks. In fact, the disposal of beach quality sand from the maintenance dredging of Morehead City Harbor on these Bogue and Shackleford Banks beaches may reduce the erosion and storm damage potential.

Public Trust Areas. These areas include waters of the Atlantic Ocean and the lands there under from the mean high water mark to the 3-mile limit of state jurisdiction. The nearshore placement areas off Bogue and Shackleford Banks are located within these Public Trust Areas. The ODMDS is located past the 3-mile limit of State jurisdiction. Acceptable uses include those that are consistent with protection of the public rights for navigation and recreation, as well as conservation and management to safeguard and perpetuate the biological, economic, and esthetic value of these areas. The activities that comprise the proposed action are not intended to adversely impact the public' rights for navigation and recreation, and are consistent with conservation of the biological, physical, and esthetic values of public trust areas.

6.12.2 Other State Policies

The following state policies found in the NC Coastal Management Program document are also applicable to the proposed action in terms of beach disposal of sand.

Shoreline Erosion Response Policies. NC Administrative Code 7M - Section .0200 addresses beach restoration projects as feasible alternatives to the loss or massive relocation of oceanfront development when public beaches and public or private properties are threatened by erosion; when beach restoration, renourishment, or sand disposal projects are determined to be socially and economically feasible and cause no significant adverse environmental impacts; and the project is consistent with state policies for shoreline erosion response and state use standards for Ocean Hazard and Public Trust Areas AECs.

Policies on Beneficial Use of Materials from the Excavation or Maintenance of Navigation Channels. NC Administrative Code 7M - Section .1101 states that it is the policy of the state that material resulting from the excavation or maintenance of navigation channels be used in a beneficial way wherever practicable. Policy statement .1102 (a) indicates that "clean, beach quality material dredged from navigation channels within the active nearshore, beach, or inlet shoal systems must not be removed permanently from the active nearshore, beach, or inlet shoal system unless no practicable alternative exists. Preferably, this dredged material will be disposed of on the ocean beach or shallow active nearshore area where environmentally acceptable and compatible with other uses of the beach."

6.12.3 Local land Use Plans

This proposed DMMP is also consistent with the policies addressed in the local Land Use Plans for Carteret County, as well as the Towns of Atlantic Beach and Pine Knoll Shores.

6.13 Coastal Barrier Resources Act (CBRA)

The proposed Morehead City Harbor DMMP is in compliance with CBRA. The Coastal Barrier Resources Act (CBRA) of 1982 (PL 97-348) and the Coastal Barrier Improvement Act of 1990 (PL 101-591) restrict federal expenditures in those areas comprising the Coastal Barrier Resources System (CBRS). Within the Morehead City Harbor project area, Fort Macon State Park Unit (NC- 04P) on Bogue Banks and Shackleford Banks (LO3A-P) within the Cape Lookout National Seashore are within the Coastal Barrier Resource System and protected under the Coastal Barrier Improvement Act of 1990. However, both the Fort Macon State Park Unit (NC-04P) and Shackleford Banks (LO3A-P) are designated “P”, which USFWS has defined as “otherwise protected area”. Since the Fort Macon State Park Unit (NC-04P) is owned by the State of North Carolina and the Shackleford Banks Unit (L03A-P) is managed by the NPS, both areas would not need protection from future private development. Additionally, USFWS defines the “P” designation as an area that is not regulated by CBRA since it is State owned property and NPS managed property, respectively. The only restriction to Federal expenditures in these “P” designated areas is that federal flood insurance cannot be obtained.

6.14 Prime and Unique Agriculture Land

According to the Soil Survey of Carteret County, North Carolina, no prime or unique agriculture lands designated by the Natural Resource Conservation Service are found within the project area.

6.15 Environmental Commitments

1. If escarpments occur on the beach after construction, the escarpment will be graded prior to the sea turtle nesting season during any given year in order to permit sea turtle nesting on the beach.

2. Should a hydraulic pipeline dredge be used offshore, the pipeline from the navigation channels to the disposal beach will be submerged until it reaches nearshore waters. The pipeline would be marked to let commercial and recreational boaters know of its presence along the bottom. Work barges and other appurtenances associated with a pipeline dredge operating in open water would be moored so as to minimize interference with boat traffic in the area.

3. Surveys of the project area for seabeach amaranth will be conducted prior to any disposal operation (construction) from 1 July to September 30 of any year.

4. Within Morehead City Harbor, some of the navigational channels are closed to shellfish harvesting. By Memorandum dated January 31, 2010, from the North Carolina Department of Environment and Natural Resources, Division of Environmental Health, Shellfish Sanitation and Recreational Water Quality Section (Appendix D), if maintenance material is excavated from these closed shellfishing areas between May 1 and October 31 and disposed of on Bogue Banks a swimming advisory will be posted and a press release made. The Wilmington District will notify the Shellfish Sanitation and Recreational Water Quality Section prior to dredging from a closed shellfishing area with disposal on a recreational swimming area.

7 DMMP REVIEW PROCESS

7.1 Agency Technical Review (ATR)

The ATR of the Morehead City Harbor DMMP Alternative Formulation Briefing (AFB) report was completed by the Deep Draft Planning Center of Expertise (DDNPCX) in May 2010. The DDNPCX completed and certified the ATR for the Draft DMMP/EIS in November 2012. All ATR information is included in Appendix M.

7.2 Public Review of the Draft DMMP/EIS

7.2.1 Scoping

On November 26, 2007, a scoping letter for the proposed DMMP was sent to federal and state agencies, interest groups, and the public requesting identification of significant resources and issues of concern. In response to the scoping letter, the public and resource agencies expressed the following major concerns: fishery resources and habitats, rare butterfly habitat, short and long-term impacts of the proposed activity, endangered/threatened species, cultural resources, sediment contamination, and other natural resources. A copy of the scoping letters and all comments are provided in Appendix D, Public and Agency Correspondence. All concerns from the scoping letters and meetings were considered in the development of the recommended plan.

On March 4, 2009, a public meeting was held to brief attendees on the Morehead City Harbor DMMP project and process, to solicit comments and input and to invite attendees to participate on the Project Delivery Team (PDT). Attendees included representatives from state and federal resource agencies, interest groups, and stakeholders. All concerns identified in response to the scoping letter and at the public meeting were considered in the development of the Draft DMMP. Several attendees of the public meeting expressed an interest in participating on the PDT and have actively participated in the development of the DMMP. The full list of participants is included in Section 13 (Project Delivery Team).

A Notice of Intent (NOI) to prepare a Draft Environmental Impact Statement (DEIS) was published in the Federal Register on March 27, 2009 and a copy of the NOI is also found in Appendix D.

In addition to the public meeting held in 2009 and involvement by various resource agencies and stakeholders throughout the planning process, USACE has also coordinated extensively with the National Park Service regarding potential DMMP measures that may impact Cape Lookout National Seashore. By letter dated February 15, 2011, USACE formally named the NPS as a cooperating agency on the DMMP (Appendix D).

By letter dated June 27, 2011, USACE initiated consultation with thirteen federally recognized tribes indentified as possibly having an interest in the project area. Only one tribe, the United Keetoowah Band of Cherokee Indians of Oklahoma (UKBCIO) responded. By letter dated July 15, 2011 the UKBCIO stated they had no objections to the DMMP, but would like to be contacted should any remains, artifacts or other items be inadvertently discovered (Appendix D).

7.2.2 Coordination of this Document

This DMMP and EIS is being provided to a standard list of federal, state, and local agencies; elected officials; environmental groups; and known interested individuals for review and comment (see list below in Section 7.4.3). After a 45-day review period for the DEIS, all input received will be considered in the preparation of the Final DMMP and EIS.

The USACE invites comments and suggestions regarding the proposed action. In accordance with Council on Environmental Quality regulations (40 CFR 1500–1508) for implementing the NEPA, comments should be as specific as possible and should be made with recognition that NEPA documents must focus on the issues that are truly significant to the proposed action rather than amassing needless detail. The NEPA process is intended to help public officials make decisions on the basis of an understanding of environmental consequences. NEPA directs that federal activities be conducted so as to attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable or unintended consequences. As individual resources and stakeholder interests increasingly compete for priority, public officials are challenged to make management decisions that reflect a balance of the overall public interest. Therefore, report comments should focus on essential issues that would be useful in guiding decisions and actions as this project proceeds.

7.2.3 Recipients of this Document

Representatives
Honorable Richard Burr
Honorable Kay Hagan
Honorable Walter B. Jones, Jr.
NC Representative Pat McElraft

Federal Agencies
Beaufort Marine Fisheries Center, National Marine Fisheries Service
Center of Disease Control
Commander, Fifth Coast Guard District
Director, Office of Environmental Compliance, Department of Energy
Director, Office of Environmental Policy & Compliance, DOI
Environmental Conservation Office, Department of Commerce, NOAA
Executive Director, Advisory Council on Historic Preservation
Federal Highway Administration
Forest Service, USDA
HUD, Atlanta Regional Office
Office of the Solicitor, Energy and Resources, U.S. Department of the Interior
Raleigh Field Office, U.S. Fish and Wildlife Service
Regional Director, National Park Service
Seymour Johnson AFB
Superintendent, Cape Lookout National Seashore
U.S. Environmental Protection Agency, Office of Federal Activities
U.S. Environmental Protection Agency, Region IV

State Agencies
CAMA Officer, Donna Turner, Town of Atlantic Beach
CAMA Officer, Chris Jones, Town of Pine Knoll Shores
North Carolina State Clearinghouse
North Carolina Division of Coastal Management

Local Government
Carteret County Board of Commissioners
Carteret County Register of Deeds
Carteret County Building Inspections, Larry Smith
Mayor, Town of Atlantic Beach
Mayor, Town of Pine Knoll Shores

Mayor, Town of Indian Beach
Town Manager, Atlantic Beach
Town Manager, Pine Knoll Shores
Town Manager, Indian Beach

Independent Groups and Individuals
Conservation Council of North Carolina
Cape Fear Group Sierra Club
Defenders of Wildlife
Dr. Vince Bellis
Dr. Robert Dolan, University of Virginia, Charlottesville
Dr. Bill Cleary, University of North Carolina at Wilmington.
Dr. Mark Posey, University of North Carolina at Wilmington
Dr. Orrin Pilkey, Duke University
Mr. Ray P. Brandi, Cape Fear Community College
National Parks and Conservation Association
National Audubon Society, Southeastern Regional Office
North Carolina Wildlife Commission
National Wildlife Federation
North Carolina Environmental Defense Fund
North Carolina Coastal Federation
North Carolina Fisheries Association
National Wildlife Refuge Association
Wilderness Society
Sierra Club Legal Defense Fund

Newspapers
Carteret County News-Times

Libraries
N.C. Collection, Wilson Library, UNC-Chapel Hill
N.C. Dept. of Environment, Health, and Natural Resources Library
Randall Library, UNC-Wilmington
State Library of North Carolina
Joyner Library, East Carolina University

8 DMMP APPROVAL AND IMPLEMENTATION

8.1 DMMP Approval

Comments received during public review of the Draft DMMP/EIS will be considered during development of the Final DMMP/EIS. Once complete, the Final DMMP/EIS will be circulated for a final public review and, if appropriate, a Record of Decision will be signed, thus completing the NEPA process. The Final DMMP/EIS may be approved by the USACE South Atlantic Division (SAD) Commander.

8.2 DMMP Implementation

Implementation of the DMMP will begin during the first dredging cycle following approval by SAD. It should be noted that maintenance of the Morehead City Harbor is currently based on a 3-year cycle, very similar to the base plan in the DMMP. Therefore, once the DMMP is approved, implementation will begin in a logical sequence and may not necessarily begin with the first year of the DMMP 3-year cycle. As an example, if dredged material is disposed of on the beaches just prior to DMMP approval then implementation will begin with year 2 of the base plan when the beach quality dredged material is to be placed in the Nearshore Placement Areas. The DMMP will be periodically reviewed and updated as appropriate.

9 CONCLUSION

It is the policy of USACE that all dredged material management studies include an assessment of potential beneficial uses for environmental purposes including fish and wildlife habitat creation, ecosystem restoration and enhancement and/or hurricane and storm damage reduction. This DMMP attempts to maximize beneficial uses of dredged material within the requirements of the federal standard. Coarse-grained material would be disposed of on the beaches of Fort Macon State Park, Atlantic Beach, Shackleford Banks or in the Nearshore Placement Areas to replenish the deflated ebb tide delta. Stakeholders strongly support disposal of coarse-grained material on the adjacent beaches. The beaches that would receive material from the Morehead City Harbor navigation project are public beaches that provide several access points for the general public.

Additionally, the proposed plan is fully consistent with the State’s Coastal Management Program, which states that clean, beach quality material from navigation channels within the active nearshore, beach, or inlet shoal systems must not be removed permanently from the active nearshore, beach or inlet shoal system unless no practicable alternative exists (15A NCAC 07M.1102 (Section 1102) (a)). Analysis of past dredging operations between years 1995 and 2006 indicates that approximately 43 percent of coarse-grained material was diverted to the ODMDS due to weather restrictions. In the future every reasonable effort will be made to reduce the amount of coarse-grained material being disposed of in the ODMDS.

Fine-grained material for which no cost effective beneficial use has yet been identified would be disposed of in either Brandt Island or in the ODMDS. Implementation of the proposed base plan would result in approximately 78% of the dredged material from the Morehead City Harbor project being beneficially used. The PDT seriously considered beneficial uses applied at other locations and the alternatives considered for this DMMP are a result of extensive coordination between the PDT, resource agencies and stakeholders.

The proposed DMMP is not expected to adversely affect the environment. The proposed Morehead City Harbor DMMP is not expected to result in any significant adverse environmental effects. Significant resources (including terrestrial and marine biota, cultural resources, threatened and endangered species, air and water quality, socio-economics, esthetics, and recreation) will not be adversely impacted by implementation of the proposed DMMP. Localized, short-term, and reversible adverse impacts to intertidal macrofauna (beach infauna) may occur. However, beach disposal areas on both Bogue Banks and Shackleford Banks would recover quickly since only beach compatible sand (≥90% sand) would be disposed of on these beaches. No long-term adverse impacts to intertidal macrofauna (beach infauna) or any other significant resources are anticipated.

The three year dredging cycle proposed for the DMMP assumes that funding will be available to dredge and monitor as planned, appropriate dredge equipment will be available, and that unexpected shoaling would not occur. The three year rotational cycle is the base plan, but must remain flexible and adjustable to meet the navigation needs of the Morehead City Harbor Navigation project, therefore, from time to time, the cycle may be adjusted, resulting in fewer dredging events and dredged material quantities that differ from those described in this DMMP. Nothing in this document should be read to suggest that material will be dredged for the purpose of disposal on the beaches or in the nearshore, or for any purpose other than addressing navigability priorities

10 NON-FEDERAL PARTNER

The State of North Carolina has statutory authority under the federal Water Resources Development Acts of 1986 & 1992 (Public Laws 99-662 and 102-580, respectively) to make binding commitments to carry out the non-federal responsibilities related to USACE projects, including making cash contributions to projects. Cost sharing is being done in accordance with the current Project Cost share Agreement (PCA), dated 15 September 1993. Specifically, the non-federal partner obligations for the Morehead City Harbor, NC navigation project are to provide all lands, easements, and rights-of-way, including suitable borrow and excavated or dredged material disposal areas, and perform, or assure performance of, all alterations or relocations of facilities and utilities (except alterations or relocations of highway bridges and railroad bridges and approaches thereto), determined by the Government to be necessary for construction, operation, maintenance, repair, replacement, and rehabilitation of the Project. The only costs incurred by the non-federal partner are approximately $50,000 annually for maintenance of the spillway boxes at Brandt Island. The general navigation features (maintenance dredging) of the Project are 100% federally funded.

11 PROJECT DELIVERY TEAM (PDT)

U. S. Army Corps of Engineers

Name	Role	Office Symbol
Bob Keistler	Project Manager	CESAW-PM-PM
Jenny Owens	Plan Formulator	CESAW-TS-PE
Frank Reynolds*	Economist	CESAW-TS-PS
Chris Graham	Economist	CESAW-TS-PS
John Mayer	Archaeologist	CESAW-TS-PE
Kevin Conner	Coastal Engineer	CESAW-TS-EC
Hugh Heine	Biologist	CESAW-TS-PE
Jimmy Hargrove	Civil Engineer	CESAW-TS-ED
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Donnie Potter	Navigation	CESAW-OP-V
Belinda Estabrook	Real Estate	CESAS-RE-RP

Resource Agencies and Stakeholders

Name	Agency
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Sara Schweitzer	NC Wildlife Resources Commission
Maria Dunn	NC Wildlife Resources Commission
Buck Fugate	Carteret County, NC
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Jodi Eshleman**	National Park Service
Mark Kinzer	National Park Service
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Julia Brunner	National Park Service
Rudi Rudolph	Carteret County, NC
Ron Sechler*	National Marine Fisheries Service
Todd Walton	NC State Ports
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12 POINT OF CONTACT

Written comments regarding this Draft DMMP and Environmental Impact Statement (DEIS) should be sent to Ms. Jenny Owens, CESAW-TS-PE, U.S. Army Engineer District, 69 Darlington Avenue, Wilmington, North Carolina 28403. Questions may be directed to Ms. Owens by telephone (910) 251- 4757 or by e-mail at jennifer.l.owens@usace.army.mil.

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US Army Corps
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APPENDICES

Morehead City Harbor
Morehead City, NC

DRAFT

Integrated Dredged Material Management Plan
And Environmental Impact Statement

Port of Morehead City, NC

October 2013

Morehead City Harbor
Morehead City, NC
DRAFT
Integrated Dredged Material Management Plan (DMMP)
and Environmental Impact Statement

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APPENDIX A

MOREHEAD CITY HARBOR
INTERIM OPERATIONS PLAN
June 2009

MOREHEAD CITY HARBOR, NC O&M

Interim Operations Plan – June 2009

1.0 EXECUTIVE SUMMARY

The Wilmington District is committed to developing and executing a Dredged Material Disposal Plan (DMMP) for the Morehead City Harbor, NC (MHC) Federal navigation project. Work on the DMMP commenced in fiscal year 2009, with completion and implementation of the DMMP currently scheduled for mid fiscal year 2011.

During this three year duration it is the Wilmington District's intent to implement an interim maintenance dredging plan (Interim Operations Plan) for the MHC project. Development of this Interim Operations Plan was performed by utilizing historical shoaling rates, actual maintenance dredging quantities, recent geotechnical data, and current channel and disposal area conditions.

Below is a summary of the Interim Operations Plan. A more detailed description of the plan can be found in Section 2.0 and the attached figures.

	Dredging Area	Disposal/Placement Location	Approx. Quantity
Year-1	Ocean Bar	Fort Macon State Park / Atlantic Beach	1,100,000 cubic yards
Year-2	Ocean Bar	Near-shore Disposal Area	250,000 cubic yards
	Inner Harbor	Brandt Island	700,000 cubic yards
Year-3	Ocean Bar	Near-shore Disposal Area	750,000 cubic yards
	Inner Harbor	Offshore Disposal Area	100,000 cubic yards

Below is a summary of the projected funding for the Interim Operations Plan through 2012 and the DMMP through 2011.

PROJECTED 3-YEAR FUNDING REQUIREMENTS
MOREHEAD CITY HARBOR, NC

ACTIVITY	**FY 10**	**FY 11**	**FY 12**	**TOTAL**
	($000)	**($000)**	**($000)**	**($000)**
CESAW Labor	250	150	150	550
Hydro Surveys	250	250	250	750
SNELL Operations	100	50	50	200
Contractor Earnings	8,400	5,400	3,300	17,100
3-Year Ops Plan TOTAL	**9,000**	**5,850**	**3,750**	**18,600**
DMMP	500	500		1,000
3-Year Ops Plan and DMMP TOTAL	**$9,500**	**6,350**	**$3,750**	**$19,600**

2. INTERIM OPERATIONS PLAN

It is the Wilmington District's intent to provide unrestricted navigation within authorized project dimensions of the MHC project while striving for the least-cost alternative, consistent with sound engineering practices, and in an environmentally acceptable manner. The District proposes to accomplish this mission through execution of various maintenance dredging contracts on a 3-year dredging cycle. This plan was developed to provide an acceptable means of maintaining MHC harbor on an interim basis while the DMMP is being developed. The final DMMP may or may not be similar to this interim plan.

The Wilmington District has structured the Morehead City Harbor maintenance dredging into a three-year dredging cycle. The Interim Operations Plan was developed with using historical shoaling and dredging quantities, recent geotechnical data, and current channel and disposal area conditions.

The following paragraphs provide a detailed description of the dredging operations planned for 2009 – 2012 (fiscal year 2010 – 2012).

2.1 Operations Plan Year-1

In Year-1, the Wilmington District plans to solicit and execute a single maintenance dredging contract. The contract would commence approximately mid-November 2009 with completion in the mid-May 2010 timeframe (see Figure entitled Year-1).

Order of Work: Approximately 1.1 million cubic yards of dredged material would be removed from the MHC Ocean Bar portion of the project and placed along the shorelines of Fort Macon State Park and Atlantic Beach. Range A would be dredged to the authorized project depths 47-ft plus two feet of allowable overdepth. The Cut-off and portions of Range B will be dredged to the authorized project depth of 45-ft plus two feet of allowable overdepth.

It should be noted that, although Range A is authorized to 47-ft plus two feet of allowable overdepth, in recent years the Wilmington District has maintained this channel to only 45-ft plus two feet of allowable overdepth based on current user traffic needs. However, under this plan in Year-1, the Wilmington District will perform maintenance dredging of Range A to the authorized depth of 47-ft plus two feet of allowable overdepth. The intent of this advanced-maintenance dredging is to maximize the dredging volume in Year-1 and minimize, or possibly eliminate, the need for dredging within the Ocean Bar portions of the project in Year-2.

2.2 Operations Plan Year-2

In Year-2, the Wilmington District plans to solicit and execute an Inner Harbor Maintenance Dredging Contract and a possible Ocean Bar contract if shoaling within the Ocean Bar warrants maintenance dredging.

Maintenance Dredging Contract 1: Approximately 700,000 cubic yards of dredged material would be removed from the MHC Inner Harbor portion of the project and disposed of within the confined disposal area of Brandt Island. The Northwest and West Legs would be dredged to 36-ft plus one foot of allowable overdepth. The East Leg and Range C would be dredged to 46-ft plus one foot of allowable overdepth. It is anticipated that this work would be accomplished with a 16-inch hydraulic pipeline dredge.

Note: maintenance dredging within portions of the MHC Inner Harbor reaches has historically been accomplished every two years. However, Year-2 dredging will require the contractor to remove dredge material to 36-ft plus one foot of allowable overdepth in West and Northwest Legs and 46-ft plus one foot of allowable overdepth in Range C and East Leg. The intent of lowering the project depth by one foot is to decrease the frequency of dredging operations from every two years to every three years. Although a minimal amount of Inner Harbor maintenance dredging may occur in Year-3, the majority will be accomplished in Year-2 and again in Year-5 if necessary.

Maintenance Dredging Contract 2: The amount of maintenance dredging in Range A, Cut-off and Range B is anticipated to be minimal due to the advanced maintenance dredging performed in Year-1. Therefore, the amount of required dredging in Year-2 will likely be a small quantity (250,000 cubic yards or less), or may not warrant any maintenance dredging. In either case, any necessary Ocean Bar dredging in Year-2 would likely be incorporated into the annual Wilmington Harbor Outer Ocean Bar maintenance dredging contract. Evaluation of channel conditions would be based on the 45-ft plus two feet of allowable overdepth (current user traffic draft requirements).

If needed, approximately 250,000 cubic yards of dredged material would be removed from Range A, Cut-off and Range B and placed within the existing nearshore placement area, utilizing the ocean dredged material disposal site (ODMDS) during adverse weather conditions (see Figure entitled Year-2). This dredging would take place within environmental dredging window of January 1 through March 31, 2011.

2.3 Operations Plan Year-3

In Year-3, the Wilmington District would solicit and execute a single maintenance dredging contract. The contract would commence approximately January 1, 2012 with completion by March 31, 2012. The contract would likely consist of a base contract with a contract option (see Figure entitled Year-3).

Base Contract: Approximately 750,000 cubic yards of dredged material would be removed from the MHC Ocean Bar portion of the project with an Ocean Certified Hopper Dredge and placed within the existing Nearshore Placement Area, utilizing ODMDS during adverse weather conditions. Range A, Cut-off and Range B would be dredged to a depth of 45-ft plus two feet of allowable overdepth.

Potential Contract Option: Based on need, approximately 100,000 cubic yards of dredged material would be removed from portions of the MHC Inner Harbor and disposed of within the ODMDS. The Northwest and West Legs would be dredged to 35-ft plus two foot of allowable overdepth and the East Leg and Range C would be dredged to 45-ft plus two foot of allowable overdepth.

2.4 Potential Continuation of Operations Plan

Completion of the MHC DMMP will provide direction for disposal of dredged material for the at least the next 20 years. The DMMP is scheduled for completion in mid-2011. Under the current schedule, the first possible year to implement dredging operations under the MHC DMMP is FY 2013, as budget submission for FY 2013 is in June of 2011. The Wilmington District will request the appropriate level of funding, in alignment with the MHC DMMP, in June 2011 for FY 2013.

3.0 HISTORICAL MAINTENANCE OPERATIONS

The Wilmington District has provided unrestricted navigation within the MHC Harbor Project through various maintenance dredging techniques and associated disposal locations throughout the life of the project. However, MHC dredging techniques were altered in 2005 following the placement of an unacceptable amount of fine-grained material onto the shoreline of Atlantic Beach and Fort Macon State Park.

3.1 Inner Harbor Channels

From the mid-1970s through 2005, the Wilmington District performed Inner Harbor maintenance dredging on an approximately 2-year dredging cycle. The Inner Harbor material was temporarily stored within Brandt Island. Approximately every 10 years, Brandt Island material was removed, via a 30-inch hydraulic pipeline dredge, and pumped to the shoreline of Fort Macon State Park and Atlantic Beach. Disposal of Brandt Island material onto the shorelines of Fort Macon State Park and Atlantic Beach was intended to mitigate for any erosion caused by channel maintenance. The Brandt Island “pumpouts” occurred in 1986, 1994 and 2005.

3.2 Ocean Bar Channels

During the same timeframe, and until 1995, dredged material from the Ocean Bar portions of the channel, to include Range A, Cut-off and Range B, was removed from the channel and placed into the ODMDS. In 1995, the Wilmington District altered the primary disposal location for the Range A, Cut-off and Range B portions of the project from the ODMDS to the "Near-shore Placement Area." This change in project disposal practices was done, in part, to satisfy new State rules indicating a preference for the retention of beach-quality sand within the littoral system.

3.3 Brandt Island Pump-out – 2005

In 2005, the Wilmington District performed the last "pumpout" of Brandt Island onto the shoreline of Fort Macon State Park and Atlantic Beach. During this operation, a considerable amount of fine-grained material was placed onto the shoreline.

3.4 Geotechnical Investigation – 2006

Following the 2005 pumpout, the Wilmington District performed extensive geotechnical investigation within the MHC project. Based on the results from this sampling effort and the State rules related to beach disposal, the Wilmington District re-classified the Inner Harbor dredged material as non-beach suitable material. Due to this re-classification, further pumpouts are no longer an option.

4.0 COMPLIANCE WITH FEDERAL STANDARD FOR DREDGING

In the first NEPA document for this project, completed in 1976, CESAW stated that it would place beach quality material dredged from the inner harbor by pipeline dredge into Brandt Island. CESAW stated in its FEIS that in order to maintain capacity in the disposal area, and to "stabilize the shoreline that is influenced by the inlet," it would pump Brandt Island out every 8 to 10 years and place the material along 25,000 linear feet of shoreline (essentially the beach at Fort Macon State Park and the Town of Atlantic Beach).

Because pumpout to the beach as described in the FEIS for Morehead City harbor is no longer available as a mechanism to return sand to the beach to offset any impacts of the project, CESAW believes it is appropriate to request sufficient funds for FY 2010, Year 1 of this interim plan, to place beach compatible material dredged from the Ocean Bar onto the beach at Fort Macon State Park and Atlantic Beach.

While nearshore placement is the least cost alternative, it does not comply with CESAW's commitment to offset potential impacts to the adjacent shoreline by placing some MHC material on the beach. The proposed Interim Operations Plan places approximately 1,100,000 cubic yards of material on the beach over a three year period (an average annual amount of 367,000 cubic yards per year). This amount is roughly equal to the average annual amount placed over the 8-year period between Brandt Island pumpouts (312,500 cubic yards per year). Because the authorized MHC plan includes disposal of material on the beach to offset potential impacts, CESAW believes the Interim Operations Plan is the short-term environmentally acceptable plan until the DMMP is completed.

Historic Shoaling Rates

Purpose: The purpose of the shoaling analysis section of this report is to determine the average amount of material that is shoaling into the navigation channel at Morehead City Harbor on an annual basis. The Morehead City Harbor navigation channel is broken into six major ranges as follows:

- Range A
- Cutoff
- Range B
- Range C / East Leg
- West Leg
- Northwest Leg

These ranges are then separated based on the quality of material contained within each area (Figure 1). Ranges that contain coarse-grained (≥90 percent sand) which is suitable for beach disposal include: Range A out to station 110+00; the Cutoff; Range B; and a portion of Range C/East Leg from the seaward extent through station 17+00. Ranges containing fine-grained (<90 percent sand) material include: Range A from station 110+00 seaward; Range C/East Leg from station 17+00 landward; the West Leg; and the Northwest Leg. Beach compatibility is based on the most recent boring log information taken from each range and is discussed in detail within the Geotechnical Appendix of this report.

Shoaling rates for the given ranges can be used to estimate several future needs with regard to disposal/placement areas, to include ensuring sufficient volume is available for the estimated disposal quantities. Also, the rates can be used to determine disposal island pumpout frequencies as well as estimate quantities available for beach disposal of acceptable sand material.

Historical Data: The basis for the shoaling study is the historical surveys collected and maintained by the Wilmington District Navigation section. The entrance channel, ocean bar, and inner harbor are surveyed on a regular basis to ensure proper depth is maintained. In addition to these condition surveys, the channel is also surveyed just prior to and immediately after dredging events. These historic surveys were collected and imported into a new diagnostic modeling tool as part of a demonstration project by Taylor Engineering (Carvalho and Albada, 2006). The focus of the tool is to provide a useful way to monitor shoal rates within navigation channels. As part of the demonstration project, surveys were processed through 2005. The remainder of the surveys through 2007 were collected and processed by the Wilmington District Coastal Engineering section as part of this shoaling calculation effort.

Assumptions: Several assumptions were made for the calculation of channel shoal rates prior to beginning the work. They are as follows:

- First, the analysis is based on a comparison of bathymetric surveys only. Due to time constraints, a comparison of the surveys to the dredging template was not made.

- Partial surveys were included in the comparison with the assumption that the survey covered all areas within the channel that may have shoaled. Surveys that were very small in coverage area were excluded.
- All comparisons were made within the lateral bounding limits of the channel polygon. Any dredging that may have occurred outside the authorized channel lateral limits was not considered. Dredging volume that occurred within the lateral limits of the authorized channel that was below the authorized depth was included in the analysis.
- Shoaling rates were generally limited to between the years 2000 and 2007 due to funding and time limitations.

Methods and Results: As discussed earlier, the Diagnostic Modeling System ESRI extension was used to compute volumetric changes between surveys. Change values were computed between surveys and categorized four ways: condition survey to before dredge survey; after dredge to before dredge survey; after dredge to condition survey; and before dredge to after dredge survey. In the absence of a valid before or after dredge survey for a given time period, the condition survey closest to the date of the missing survey would be used as a substitute to measure trends.

Once volume differences were computed between survey events they were sorted to group similar survey dates. Survey comparisons between common dates, i.e. two different condition surveys compared to the same before dredge survey, would have their individual shoal rates averaged to produce one shoal rate that represented this time period. Once all shoal rates were computed the average shoal rate for the type of comparison, i.e. after dredge to condition, would be computed. This would ultimately produce three shoal rates, one each for the after dredge to condition, the condition to before dredge, and the after dredge to before dredge. These three rates would then be averaged into what is used as the representative shoal rate for a particular section of the channel. Final shoaling rates for each section of the navigation channel are shown in Table 1.

Historic Dredge Volumes:

Purpose: In an attempt to correlate the newly developed shoaling rates with the amount of material historically dredged from the channel, an average annual dredging rate was developed based on the historic dredge volumes.

Historic Data: The navigation channel and inner harbor was broken into six regions based on historic dredging contracts between 1997 and 2008, as follows:

- Range A
- Cutoff
- Range B
- Range C / East Leg
- West Leg
- Northwest Leg

Unlike shoaling rates developed previously using the actual survey data, these data were not separated into beach quality material and non-beach quality material. This was due to the limited nature of the available contract data which typically only includes channel quantities for before dredge and after dredge conditions, as well as the overdepth volume. Overdepth volume is material dredged beyond the authorized channel template and is subtracted from the volume calculated based on the before dredge and after dredge surveys. This final pay quantity was used as the basis for developing the average annual dredging rates for historic dredging.

Methods and Results: Actual pay volume quantities were organized into one of the six regions described above by survey date. Due to the variability of the number of dredging events for each reach and the time between surveys, an average was computed for both the dredge volume and duration between events. These average values were then used to compute the average annual dredging rate by dividing the average volume dredged by the average duration between dredging events. A summary of the results is shown in Table 1.

To make comparisons between the shoaling rate and the average annual dredging rate calculations, ranges for the survey based shoaling rates had to be combined into the six ranges used in the dredging rate analysis. The last column in Table 1 shows the substantial difference in the two calculation methods. There are multiple explanations for the differences observed between the two methods. The first reason for the difference is that the average annual dredging rate does not include material dredged from outside the channel template as a result of it being based on pay quantities only. Secondly, material that shoals into the navigation channel during the dredging process is unaccounted for in the pay quantities. The period of time that a contractor occupies a section of the navigation channel for dredging varies, but can range between four to eight weeks for a typical section. Since contracts are typically paid based on material removed between after dredge and before dredge surveys, the contractor must remove the amount specified in the construction contract and shoaling during construction as well. For example, an eight week dredging operation would remove roughly 15 percent of anticipated yearly shoaling which would not be represented in the final quantity. The third reason for shoaling rates to be higher than average annual dredging rates would be that previous dredging events may have not removed all shoaling within the channel. Shoaling that occurs within the channel, but does not restrict navigation may not be removed until such point that it becomes a navigational issue. Also, shoaling has occurred in areas such as the Shackleford Banks spit at the intersection of Range A and the Cutoff where the typical hopper dredging plant is unable to dredge the navigation channel to its full alignment. Lastly, maintenance of the project is frequently limited by funding.

Given these differences, the most reliable tool to predict shoaling volumes within the channel would be the survey based shoaling rates applied over the anticipated period between dredging events.

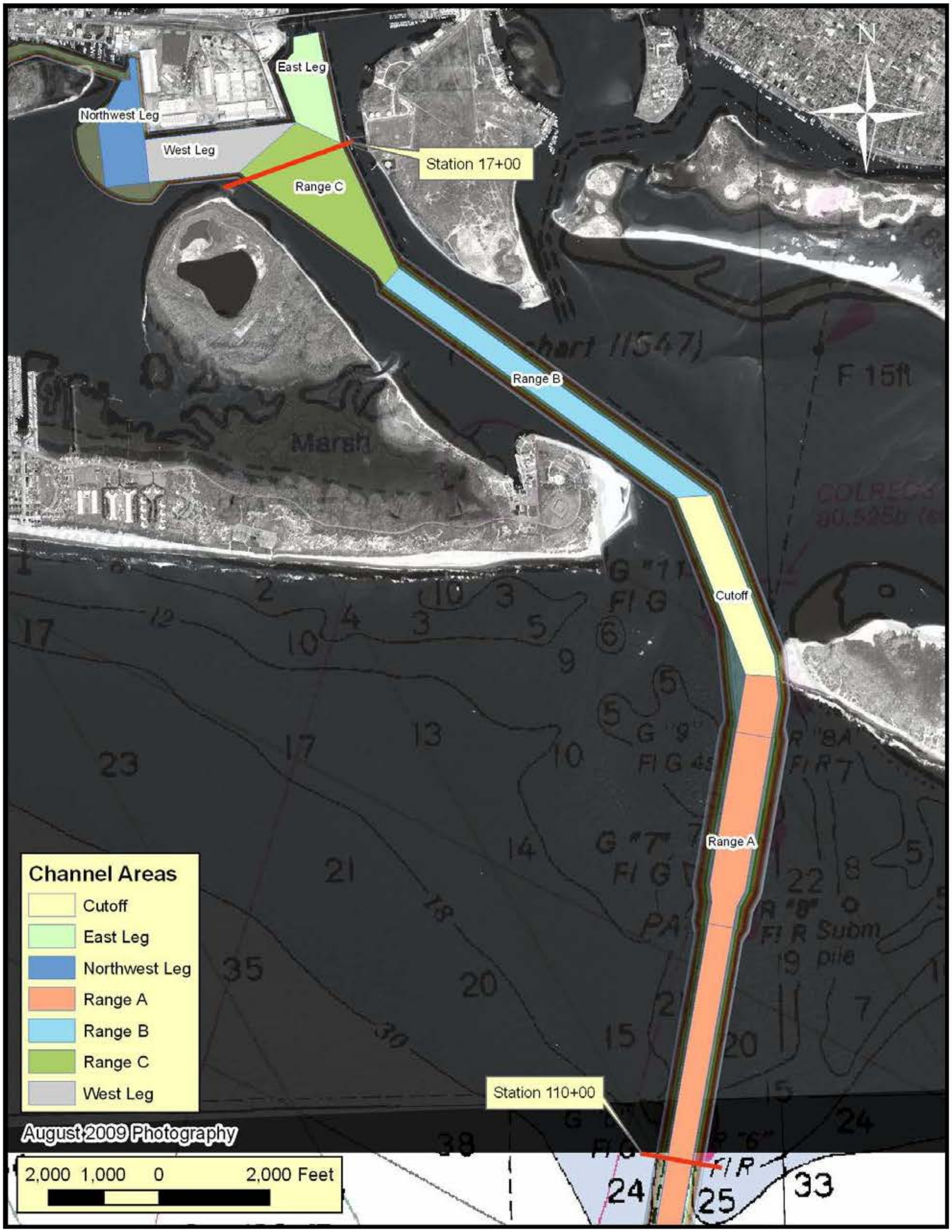

East Leg
Northwest Leg
West Leg
Station 17+00
Range C
Range B
Cutoff
Range A
Station 110+00
Channel Areas
Cutoff
East Leg
Northwest Leg
Range A
Range B
Range C
West Leg
August 2009 Photography
2,000 1,000 0 2,000 Feet

Figure 1

	Shoaling Rates Based on Survey Comparison (AD, BD, and Condition Surveys 2000-2007)				Average Annual Dredging Rates (1997 - 2008)		
Range	Representative Shoaling Rate (C.Y./Year)	Shoaling Rate (C.Y./day)	Combined Shoaling Rate (C.Y./Year)	Combined by Range (C.Y./Day)	Representative Dredging Rate (C.Y./Year)	Dredging Rate (C.Y./day)	% Difference
Range A Suitable	630,500	1,727					
Range A Unsuitable	118,500	325	749,000	2,052	547,600	1,500	-26.89%
Range B	170,000	466	170,000	466	45,400	124	-73.29%
Cutoff	324,500	889	324,500	889	182,500	500	-43.76%
Range C Eastleg Suitable	80,500	221					
Range C Eastleg Unsuitable	86,000	236	166,500	456	138,200	379	-17.00%
West Leg	28,000	77	28,000	77	23,200	64	-17.14%
Northwest Leg	80,000	219	80,000	219	60,900	167	-23.88%

Table 1

Reference:

Carvalho, Alexandra, Ph.D. and Edward Albada, P.E., 2006. “Morehead City Harbor DMS Data Manager Application Carteret County, North Carolina”, Taylor Engineering, Jacksonville, FL.

APPENDIX B

GEOTECHNICAL ENGINEERING

GEOTECHNICAL ENGINEERING

General.

The project site is located in the lower Atlantic Coastal Plain physiographic province along the central coast of North Carolina. More specifically, the channel passes through Beaufort Inlet between the barrier islands of Shackleford Banks and Bogue Banks and continues inland to the mainland at Morehead City and Beaufort, North Carolina. The channel is flanked by shoals of the ebb-tidal delta seaward of the inlet and by those of the flood-tidal delta landward along Back Sound on the east. Further inland, the channel is flanked by Bogue Sound on the west. The Newport River empties into Morehead City harbor at the head of the channel, i.e., the northern most end of the harbor. The project site encompasses depositional environments that include nearshore littoral settings, an active coastal inlet, barrier islands, and a shallow, back-barrier lagoonal complex of sounds and channels. The prominent geographical feature of the region is Cape Lookout which is composed of a lobate sand body ranging up to 90 feet in thickness and covering an area of approximately 100 square miles. The western edge of the Cape Lookout shoal lies immediately east of the entrance channel. Shackleford Banks is a Holocene age barrier island that is underlain by extensive deposits of inlet-fill sediments along its entire length. Historically, an inlet or inlets have opened and closed along the full length of the island, while displaying an overall westward lateral movement to the present-day Beaufort Inlet location. Back Sound, landward of Shackleford Banks, is underlain by stacked sequences of flood-tidal delta deposits which stratigraphically compliment the inlet-fill sequences under the island. Bogue Banks, to the west of the channel, is underlain by Holocene age shoreface deposits. The barrier sands of the island are prograding seaward over these deposits at present. Bogue Sound, landward of this island, is underlain by a back-barrier lagoonal sequence of sediments having a greater abundance of clays than Back Sound to the east. The entire sequence of barrier/back-barrier sediments in the area represents several transgressive/regressive ocean events that occurred during Pleistocene and Holocene time.

Soils and Geology.

Sediments within the project scope (reach and depth) range from Pliocene to Holocene in age. The Pliocene sediments are from the Yorktown formation and are only found in limited areas, i.e., the turning basin and possibly along portions of Ranges "C" and "B". The top of the Yorktown sediments range between -45 and -50 Mean Sea Level in the inner harbor area and to about -65 msl at Beaufort Inlet. These sediments consist of bluish to greenish-gray, clayey sands and interbedded clay and sandy clay, all of which have abundant fossil debris. Generally, the Yorktown is more indurated than the overlying sediments. The Pleistocene sediments are from the Core Creek Sand. Within the inlet, these sediments are at approximately -50 to -54 feet msl. Beneath Bogue Banks and Shackleford Banks, the Pleistocene varies from -45 msl to -55 msl, respectively. In the landward direction, the top of the, Core Creek Sand rises along dip such that it is only 15 to 20 feet below mean sea level. Pleistocene deposits from the Beaufort Sand form a ridge along the mainland at the rear of Back and Bogue Sounds, as part of the Core Creek Plain (Pamlico Plain of Stephenson, 1912). This plain is a shallow, seaward dipping surface which lies east and south of the Suffolk Scarp. In general, the Pleistocene sediments in the project area are representative of back-barrier and nearshore or shoreface deposits consisting of interbedded clays, silts and fine sands, and poorly graded fine to medium sands and shelly sands, respectively. Holocene sediments are undifferentiated. They are the uppermost sediments at the site. Within the inner harbor, they consist of some reworked clays and silts but are predominately very fine to fine sands that are derived from Bogue and Back Sounds and the Newport River. Coarser sediments are concentrated in the channels. Holocene deposits at the inlet and entrance channel consist of fine to medium and some coarse sands containing quartz and abundant shell fragments. These deposits are derived from the ongoing reworking of older sediments along the nearshore seabed and the Cape Lookout sand body. Deposits in each of the stratigraphic units are interbedded vertically and interfinger horizontally(facies changes) as the environments of deposition changed across the project area.

Subsurface Investigations.

1972 Harbor Investigation.

Forty (40) Vibracore borings, designated through 40, were completed in 1972 between the ocean bar at the entrance to the channel and the head of the harbor. The borings were performed in Range A, the Cutoff, Range B, Range C, and the East Leg. Grain size analysis was not conducted on these cores. All vibracore borings were made using a 20 foot corer. Borings penetrated sediments from as shallow as -24.2 feet to as deep as -62.4 feet Mean Low Water(mlw). All borings penetrated to a minimum depth of -45 mlw, except No. 33 which stopped at -44.2 mlw. All drill sites were within the channel or harbor prism. The authorized depth of the project at the time the borings were performed was -40 mlw.

1990 Harbor Investigation

In 1990 a subsurface investigation was performed, consisting of 10 borings designated MHC-90-#. Although 18 borings were planned, only 10 borings were actually drilled. These borings were MHC-90-5, 7, 9, 11, 12, 13, 15, 16, 17, and 18. A modified splitspooning technique was used to obtain samples for visual and laboratory analysis. The samples were taken with a 5 foot splitspoon which was driven with a 300 pound hammer. No n value was kept as using this equipment for sampling does not meet the requirement in ASTM for the standard splitspoon test. Sieve analyses were conducted on representative samples to determine if the soils are suitable for disposal on adjoining beaches. Twenty-four of the twenty six samples recovered were grain size tested in accordance with ASTM D 422. The sieves used in the grain size testing were the 1", ¾", ½", 3/8", #4, #10, #20 #40 #60, #100, #200 sieves.

1992 Harbor Investigation

In 1992 a subsurface investigation was performed, consisting of 12 borings designated MH-92-#. The borings were performed in Range B, Range C, and the East Leg. The borings were performed from the USACE multi-purpose vessel SNELL using a 20' vibracore. Fifty four of the sixty seven samples recovered were grain size tested in accordance with ASTM D 422. The sieves used in the grain size testing were the 1½", 1", ¾", ½", 3/8", #4, #7, #10, #14 #18 #25 #35 #45 #60 #, #230 sieves.

<u>2003 Harbor Investigation</u>

In 2003 a subsurface investigation was performed, consisting of 21 borings designated MIH-03- V-#. The borings were performed in Range C, the West Leg, the East Leg, and the Northwest Leg, on shoals to be removed in the next maintenance dredging contract. The borings were performed from the SNELL using a 20' vibracore. Samples recovered which were within the dredging prism were grain size tested in accordance with ASTM D 422. The sieves used in the grain size testing were the 3/4", 3/8", #4, #7, #10, #14, #18, #25, #35, #45, #60, #80, #120, #170, #200 sieves.

<u>2005 Harbor Investigations</u>

In 2005 a subsurface investigation was performed, consisting of 8 borings designated MIH-05-V-#. The borings were performed in Range C, the West Leg, the East Leg, and the Northwest Leg, on shoals to be removed in the next maintenance dredging contract. The borings were performed from the SNELL using a 20' vibracore. Samples recovered which were within the dredging prism were grain size tested in accordance with ASTM D 422. The sieves used in the grain size testing were the 3/4", 3/8", #4, #7, #10, #14, #18, #25, #35, #45, #60, #80, #120, #170, #200 sieves.
Later in 2005 another subsurface investigation was performed, consisting of 15 borings designated MOB-05-V-#. The borings were performed in Range A, on shoals to be removed in the next maintenance dredging contract. The borings were performed from the SNELL using a 20' vibracore. Samples recovered which were within the dredging prism were grain size tested in accordance with ASTM D 422. The sieves used in the grain size testing were the 3/4", 3/8", #4, #7, #10, #14, #18, #25, #35, #45, #60, #80, #120, #170, #200 sieves.

<u>2006 Harbor Investigation</u>

In 2006 a subsurface investigation was performed, consisting of 30 borings designated MHC-06-V-#. The borings were performed in Range C, the West Leg, the East Leg, and the Northwest Leg, on shoals to be removed in the next maintenance dredging contract. The borings were performed from the SNELL using a 20' vibracore. Samples recovered which were within the dredging prism were grain size tested in accordance with ASTM D 422. The sieves used in the grain size testing were the 3/4", 3/8", #4, #7, #10, #14, #18, #25, #35, #45, #60, #80, #120, #170, #200 sieves.

<u>2007 Harbor Investigation</u>

In 2007 a subsurface investigation was performed, consisting of 11 borings designated MHCOB-07 V-#. The borings were performed in Range A, on shoals to be removed in the next maintenance dredging contract. The borings were performed from the SNELL using a 20' vibracore. Samples recovered which were within the dredging prism were grain size tested in accordance with ASTM D 422. The sieves used in the grain size testing were the 3/4”, 3/8”, #4, #7, #10, #14, #18, #25, #35, #45, #60, #80, #120, #170, #200, #230 sieves.

<u>2008 Harbor Investigation</u>
Borings designated MHC-08-V-# are vibracore borings performed in 2008. These sixty one borings are located throughout the Morehead City Harbor in Range A, the Cutoff, Range B, Range C, the West Leg, the East Leg, and the Northwest Leg. They represent the most comprehensive set of borings performed to date for the identification of material to be dredged. The samples from these borings were visually classified and all samples within the dredging prism were grain size tested in accordance with ASTM D 422. The sieves used in the grain size testing were the 3/4”, 3/8”, #4, #7, #10, #14, #18, #25, #35, #45, #60, #80, #120, #170, #200, and #230 sieves.

Borings that were performed from the SNELL from 2003 to the present were drilled using a 3 7/8 inch diameter, 20 foot long, Alpine vibracore drill machine. The sampler consists of a metal barrel in which a plastic cylinder is inserted. After the plastic tube was inserted, a metal shoe was screwed onto the plastic tube and then the metal barrel. The shoe provided a cutting edge for the sampler and retained the plastic tube. An air-powered vibrator was mounted at the upper-most end of the vibracore barrel, and the vibrator and the vibracore barrel were mounted to a stand. This stand was lowered to the ocean floor by the SNELL’s crane; the vibrator was activated and vibrated the vibracore barrel into the ocean sediment. The sediment sample is retained in the plastic cylinder. All borings were drilled to a depth of 20 feet below the ocean floor, unless vibracore refusal was encountered. Vibracore refusal was defined as a penetration rate of less than 0.1 feet in 10 seconds.

<u>2009 Brandt Island Investigation</u>
A comprehensive subsurface investigation was performed along the proposed dike alignment in 2009. This subsurface investigation is described in detail beginning on page B-14.

HARBOR SEDIMENT MATERIAL

The purpose of these sediment analyses was to determine the material types in the Morehead City Harbor and to delineate areas within the Harbor for the proper disposal location of the harbor dredge material. It is important to designate the sand material properly in order to place this valuable resource in the most appropriate location. The amount of the fine grained material in the harbor sediments will determine if the sediment is beach compatible or if it must be placed in the ODMDS or a confined disposal facility.

As described above and shown on Figure B-1, numerous borings have been performed in the Morehead City Harbor over the years. Many of those borings were for purposes other than to determine the suitability of disposal and therefore do not have the grain size testing that would be required to make a disposal decision. This analysis only uses the borings which have enough grain size data to make a determination of proper disposal.

For this analysis, five sets of borings with lab testing were used. These borings were performed between 2005 and 2008.

Borings designated MIH-05-V-# are vibracore borings performed in 2005. These borings are located in Range C. Borings designated MOB-05-V-# are vibracore borings also performed in 2005. These borings are located in Range A. Borings designated MHC-06-# are vibracore borings performed in 2006. These borings are located in Range C. Borings designated MHCOB-07-V-# are vibracore borings performed in 2007. These borings are located in Range A. All samples obtained from these borings within the channel were lab tested.

Borings designated MHC-08-V-# are vibracore borings performed in 2008. These borings are located throughout the Morehead City Harbor from range C to Range A. They represent the most comprehensive set of borings performed to date for the identification of material to be dredged.

Borings were performed from the USACE vessel SNELL using a 3 7/8 inch diameter, 20 foot long, Alpine vibracore drill machine. The SNELL is a 104-foot long multi-purpose vessel with a crane that lifts the vibracore machine. The crane is rated at 70 tons and is capable of lifting up to 35 tons. The sampler consists of a metal barrel in which a plastic cylinder is inserted. After the plastic tube was inserted, a metal shoe was screwed onto the plastic tube and then the metal barrel. The shoe provided a cutting edge for the sampler and retained the plastic tube. An air-powered vibrator was mounted at the upper-most end of the vibracore barrel, and the vibrator and the vibracore barrel were mounted to a stand. This stand was lowered to the ocean floor by the SNELL's crane; the vibrator was activated and vibrated the vibracore barrel into the ocean sediment. The sediment sample is retained in the plastic cylinder. All borings were drilled to a depth of 20 feet below the ocean floor, unless vibracore refusal was encountered. Vibracore refusal was defined as a penetration rate of less than 0.1 feet in 10 seconds.

All samples within the channel limits were tested in accordance with ASTM D 422. The sieves typically used in the testing were the 3/4", 3/8", #4, #7, #10, #14, #18, #25, #35, #45, #60, #80, #120, #170, #200, and #230 sieves.

The borings were broken into three categories, green, yellow and red. The "green" borings contain 10% or less fine grained material. The "yellow" borings contain less that 20% fine grained material but more than 10%. Finally the "red" borings contain greater than 20% fine grained material. The percentage of fine grained material was determined from the grain size testing and the percent passing the #200 sieve.

The Harbor areas are grouped based on the amount of sand and fine grained material contained in the sediment to be dredged. There are a few isolated areas which may contain material which is not consistent with the predominate material, but it is believed that these areas are anomalies and do not change the overall material types.

Based on the information available at the present time, there are three distinct areas within the Morehead City Harbor. They are the western portion of the West Leg (West Leg 1), the Northwest Leg, the East Leg, and Range A from station 117+00 out to the end of Range A is the first area. This portion of the harbor consists predominantly of silt, silty sand, sandy silt and some clean sand. The material in this area contains less than 80% sand which is too much fine grained material to meet the beach or nearshore placement requirements and should be placed upland in the Brandt Island confined disposal area or in the ODMDS.

The second area is the eastern portion of the West Leg (West Leg 2), the northern portion of Range C, and Range A from station 117+00 to Station 100+00. This portion of the harbor consists of slightly silty sand, and clean sand. The material in this area contains between 80% and 90% sand and may be placed in the Nearshore East or Nearshore West placement areas, the ODMDS, or upland in the Brandt Island confined disposal area.

The third area is the southern portion of Range C, all of Range B, all of the Cutoff, and Range A out to station 110+00. This portion of the Harbor consists of slightly silty sand, and clean sand. The material in this area contains greater than 90% sand and meets the requirement for beach or nearshore placement. Some of this coarse grained material may be placed in the ODMDS when inclement weather hinders hopper dredge placement in the nearshore areas.

Brandt Island

HISTORY. Brandt Island is approximately 168 acres in size and located south of the existing Port of Morehead City, across the Morehead City Channel. The island has been used as a disposal area since 1955 and is divided from the Bogue Banks barrier island by the narrow Fishing Creek. Immediately to the southeast is a US Coast Guard facility and Fort Macon State Park.

Brandt Island is owned and has previously been used as a sand-recycling site by the NCSPA and dedicated for the purpose of dredged material disposal. Brandt Island has a present capacity of about 3 million cubic yards, which can be increased by about 1 million cubic yards by reworking the dikes every four to five years. In 1986, 1994, and 2005 approximately 3.9 million, 2.5 million, and 2.9 million cubic yards of dredged material were pumped out of Brandt Island and placed on the beaches of Bogue Banks from Fort Macon State Park to Atlantic Beach, respectively.

Brandt Island has historically received material that is both suitable and unsuitable for beach disposal. In 2005 a cross dike was constructed inside Brandt Island at elevation 14 for purposes of segregating the unsuitable material from the suitable beach quality material. As Brandt Island is the only upland facility available for receipt of non- beach quality material, the cell for receipt of unsuitable material has reached capacity for the current dike height. Pump out of the beach quality material remaining in Brandt Island will be difficult due to the amount of non-beach disposal material presently inside the confined disposal facility. The difficulty will be trying to avoid the non-beach quality material and keeping it from mixing with the beach quality material.

EXISTING DIKE. The existing dike encompasses approximately 64 acres and has a controlling top of dike elevation of approximately 37 feet (Figure B-2). It is assumed that 2 feet of freeboard will be required at all times during disposal operations and water and dredged material will not be allowed above elevation 35 feet within the disposal area. The existing available storage volume below elevation 35 feet is approximately 3 million cubic yards. The existing dredged material capacity is approximately 1.5 million cubic yards assuming a bulking factor of 2. The dredge material capacity is the volume of the in place material in the channel.

ALTERNATIVES. Various alternatives of the Brandt Island Dike were considered for use to confine material disposed of from the Morehead City Harbor. Two alignments of the dike were considered. The first alignment considered is to keep the dike alignment approximately the same as the present dike. The second alignment considered is to expand the dike as much as possible without encroaching on wetlands or private property (Figure B-3).

The proposed dike is assumed to have a 15 foot top width and 3 horizontal to 1 vertical side slopes. The dike alignment will be adjusted as needed to minimize the amount of fill required. The toe of the expanded dike alignment will be fitted to avoid wetlands and private property, and to also allow a construction buffer to allow for a work area adjacent to the toe.

Table B-1, below, shows the amount of fill needed to raise the Brandt Island dike along an existing alignment and Table B-2 shows the fill needed to raise the Brandt Island Dike along the expanded alignment and the total dredged material capacity resulting from each proposed dike raise. It should be noted that numbers below include the current remaining storage volume of 3 million cubic yards.

Existing Dike Alignment		
Dike Height (el)	**Dike Fill Volume (CY)**	**Total Storage Volume (CY) (assumes dike fill comes from interior of diked area)**
42	62,000	3,482,000
47	191,000	3,854,000
52	398,000	4,142,000
55	582,000	4,244,000

Table B-1. Proposed Brandt Island Dike Raises Along the Existing Alignment

Expanded Dike Alignment		
Dike Height (el)	**Dike Fill Volume (CY)**	**Total Storage Volume (CY) (assumes dike fill comes from interior of diked area)**
42	442,000	4,668,000
47	657,000	5,484,000
52	917,000	6,278,000
55	1,088,000	6,749,000

Table B-2. Proposed Brandt Island Dike Raises Along an Expanded Alignment

Four dike heights were investigated to determine if it is economical to raise the existing dike. Dike heights investigated included elevations 42 feet, along with elevations 47, 52, and 55 feet. The amount of fill needed to construct these dike heights along the existing alignment are approximately 64,000 cubic yards (CY), 191,000 CY, 398,000 CY, and 582,000 CY respectively. The storage capacity for each of these heights is approximately 3,482,000 CY, 3,854,000 CY, 4,142,000 CY, and 4,244,000 CY respectively.

The amount of fill needed to construct these dike heights along the expanded alignment are approximately 442,000 CY, 657,000 CY, 917,000 CY, and 1,088,000 CY respectively. The storage capacity for each of these heights for the expanded dike is approximately 4,668,000 CY, 5,484,000 CY, 6,278,000 CY, and 6,749,000 CY respectively.

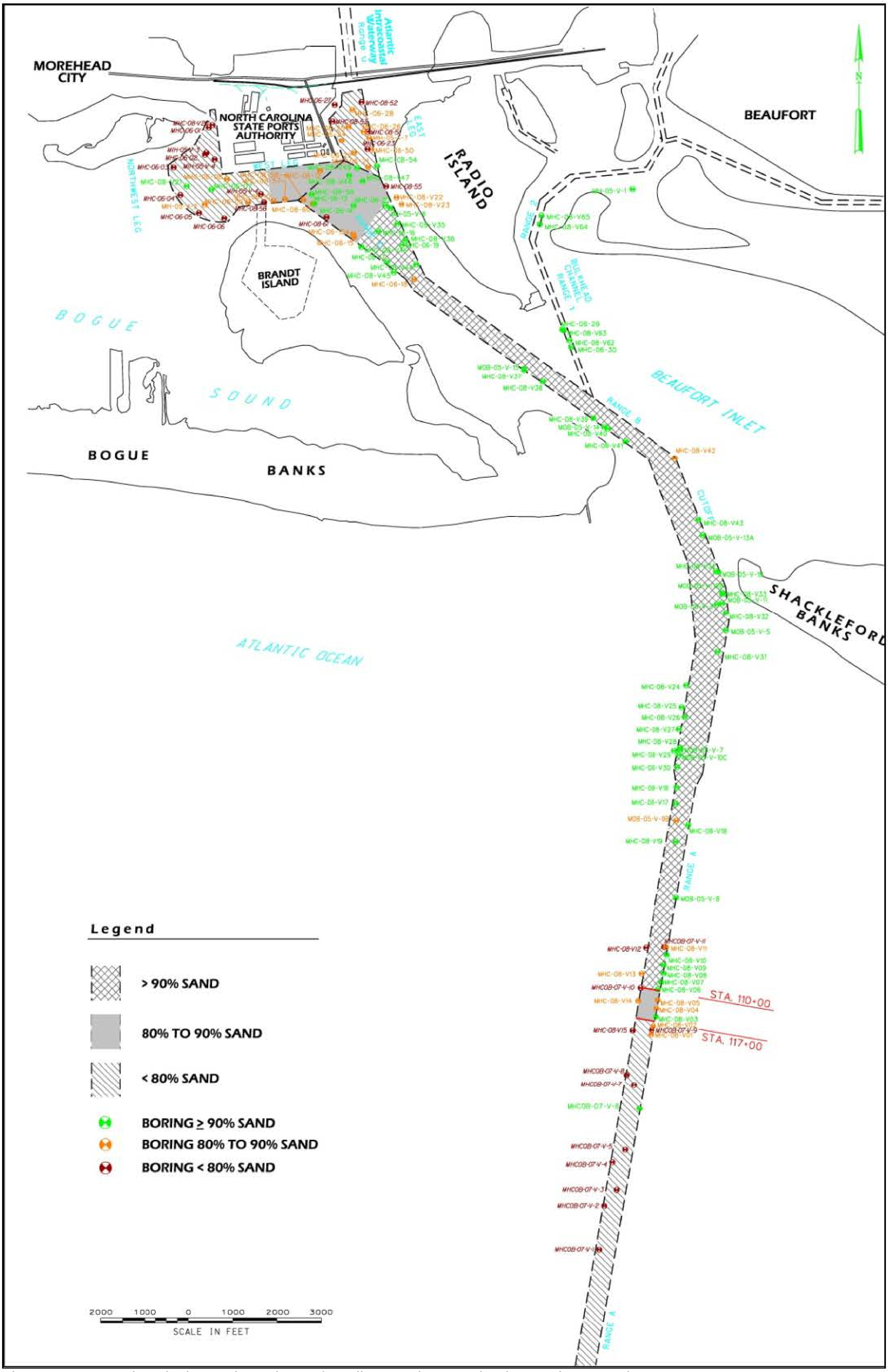


Figure B-1. Morehead City Harbor Channel Sediment Characterization Boring Locations

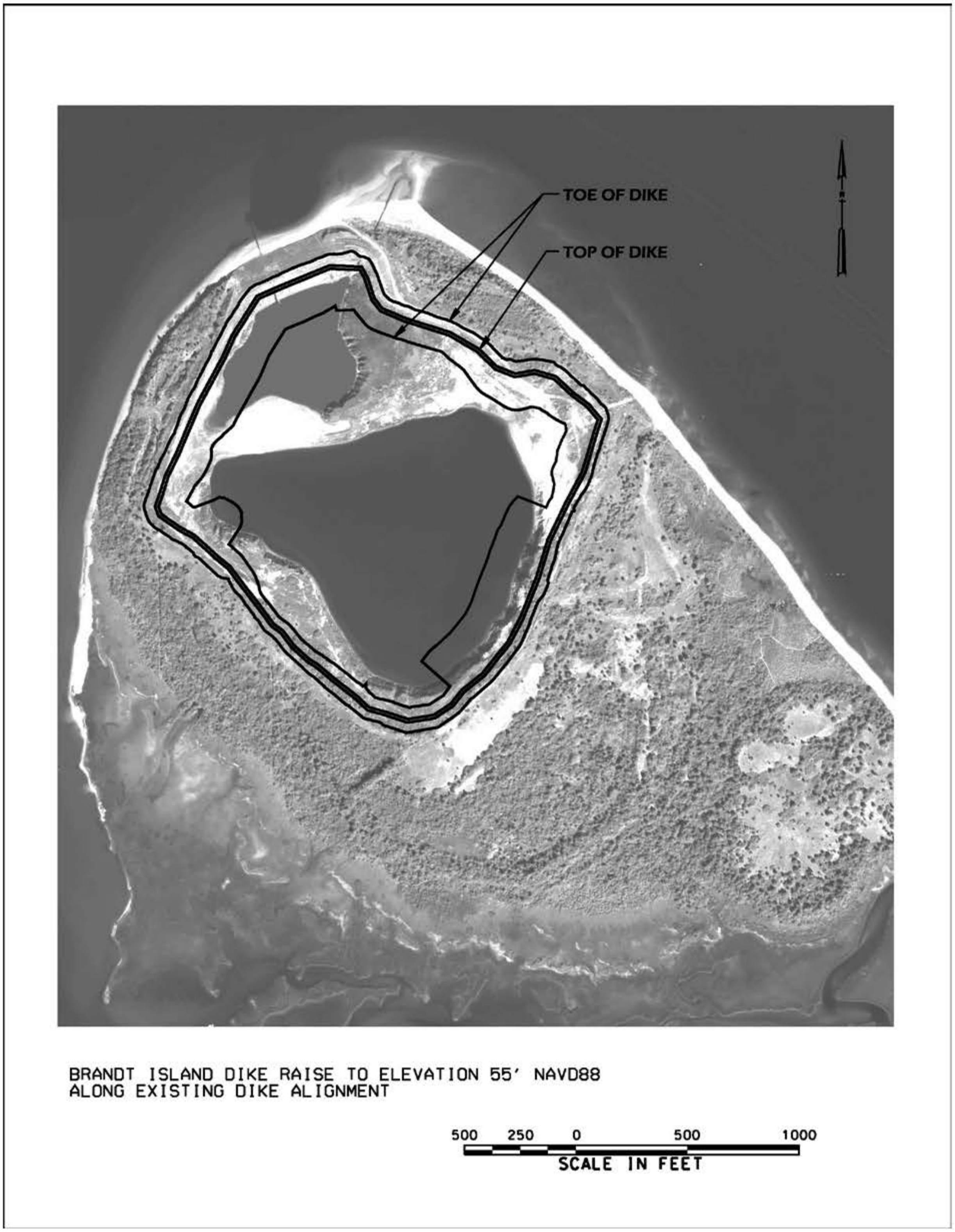


Figure B-2. Existing Alignment of Brandt Island Dike with Dike Raise to Elevation 55'

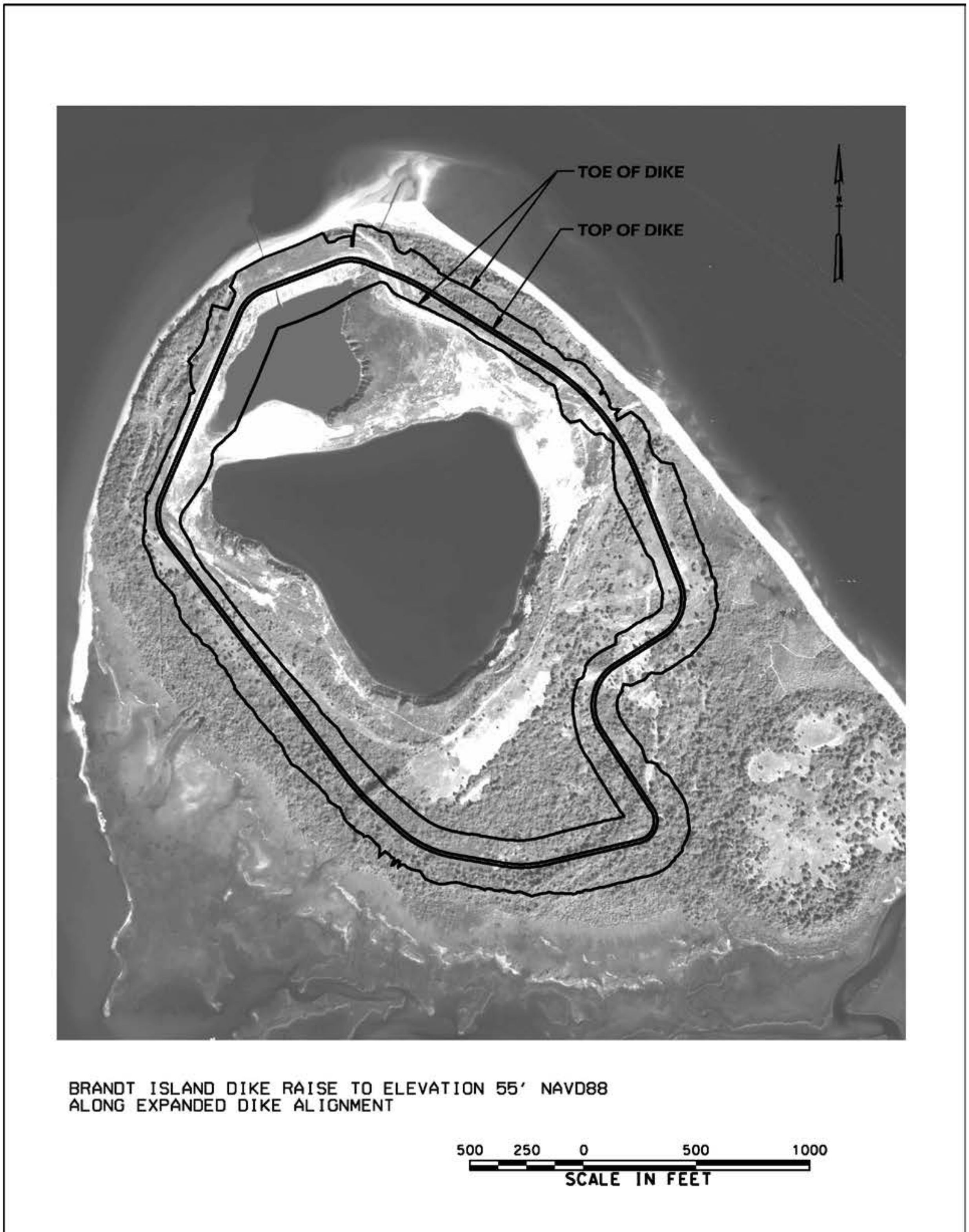


Figure B-3. Proposed Expansion of Brandt Island Dike with Dike Raise to Elevation 55'

SUBSURFACE INVESTIGATION. A comprehensive subsurface investigation was performed along the proposed dike alignment in 2009. The drilling program consisted of performing eighteen Standard Penetration Test (SPT) borings reaching depths of 51 to 78 feet along the proposed dike alignments. The SPT borings were performed using the general methodology outlined in ASTM Standard D 1586 (Figures B-4 and B-5).

The standard penetration test is a widely accepted test method of *in situ* testing of foundation soils (ASTM D 1586). A 2-foot long, 2-inch outside diameter split-barrel sampler attached to the end of a string of drilling rods is driven 18 inches into the ground by successive blows of a 140-pound hammer freely dropping 30 inches. The number of blows needed for each 6 inches of penetration is recorded. The sum of the blows required for penetration of the second and third 6-inch increments of penetration constitute the test result or N-value. After the test, the sampler is extracted from the ground and opened to allow visual examination and classification of the retained soil sample. The N-value has been empirically correlated with various soil properties allowing a conservative estimate of the behavior of soils under load. The tests are usually performed at 5-foot intervals. However, more frequent or continuous testing was done by the drilling AE through depths where a more accurate definition of the soils is required. The test holes are advanced to the test elevations by rotary drilling with a cutting bit, using circulating fluid to remove the cuttings and hold the fine grains in suspension. The circulating fluid, which is a bentonitic drilling mud, is also used to keep the boring open below the water table by maintaining an excess hydrostatic pressure inside the hole. Representative split-spoon samples from the soils at every 5 feet of drilled depth and from every different stratum are brought to the laboratory in air-tight jars for further evaluation and testing, if necessary. After completion of a test boring, the hole is kept open until a steady state groundwater level is recorded. The hole is then sealed, if necessary, and backfilled.

The borings were advanced using a CME 45 Mud Bug drilling equipment. Field logs for each boring were prepared by an Ardaman & Associates, Inc., field geologist. These logs included visual classifications of the material encountered during drilling. Soil samples were obtained continuously from the ground surface to the termination depth of the boreholes. The soil samples were visually classified in general accordance with the Unified Soil Classification System (ASTM D 2487). In cohesive and semi-cohesive soils, undisturbed soil samples were secured using three inch diameter thin-walled tube in accordance with ASTM Standard D 1587 (Shelby tube sampler). The Shelby tube was retrieved, plugged and sealed by the field personnel on site. All soil samples recovered during the drilling program were brought back to the Ardaman & Associates, Inc. laboratory in Orlando, Florida for additional classification and testing. All laboratory tests, where applicable, were performed in general accordance with ASTM standards. The laboratory testing program was conducted in our USACE approved laboratory in Orlando, Florida on selected samples from the field exploration. The program included visual classification, moisture content, particle-size distribution and Atterberg limits determinations on selected samples. In addition, twelve consolidation tests, nine unconsolidated undrained triaxial compression (UU) tests, and one laboratory vane shear test were performed on undisturbed soil samples.

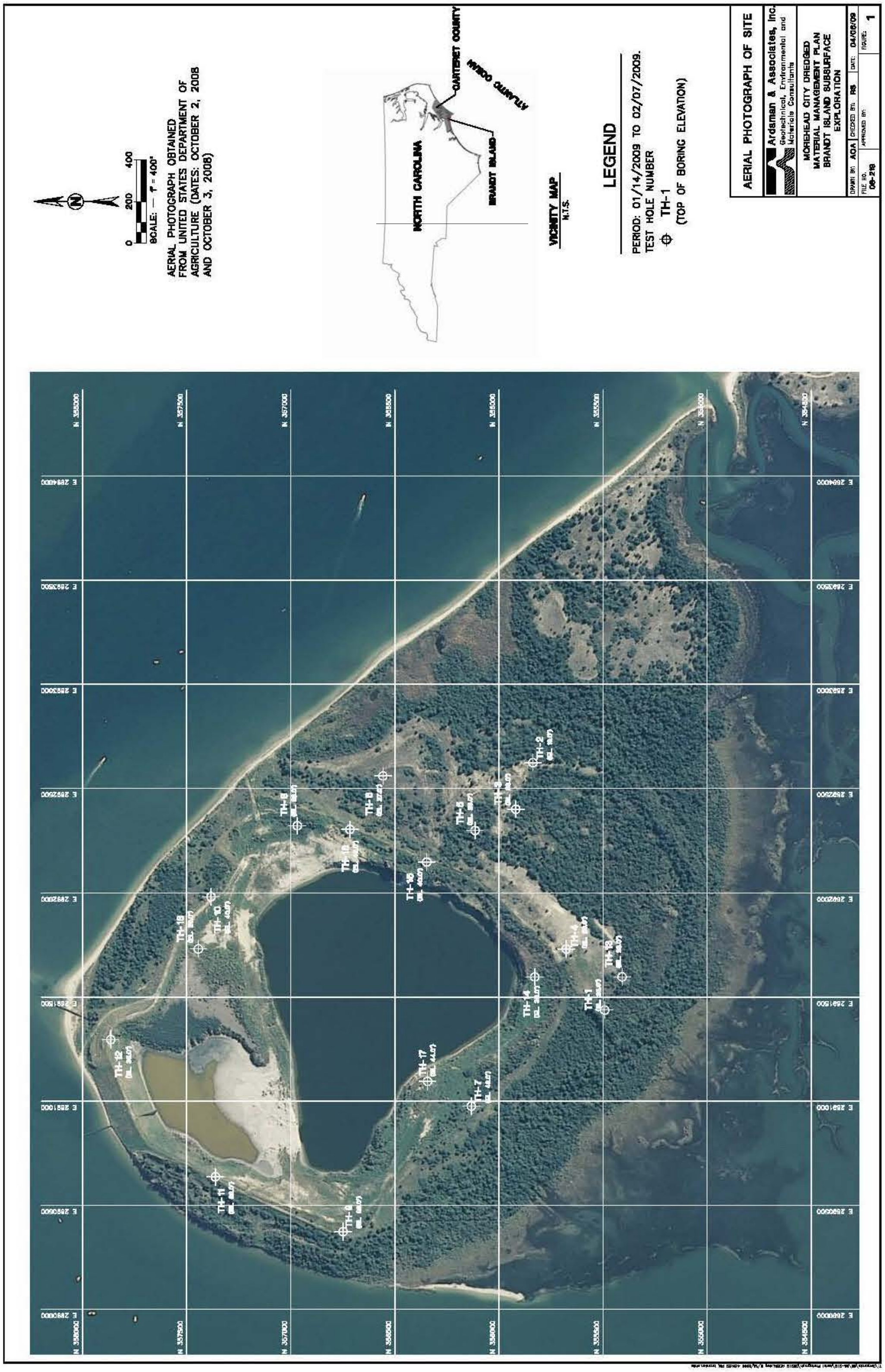


Figure B-4. Brandt Island Soil Boring Locations

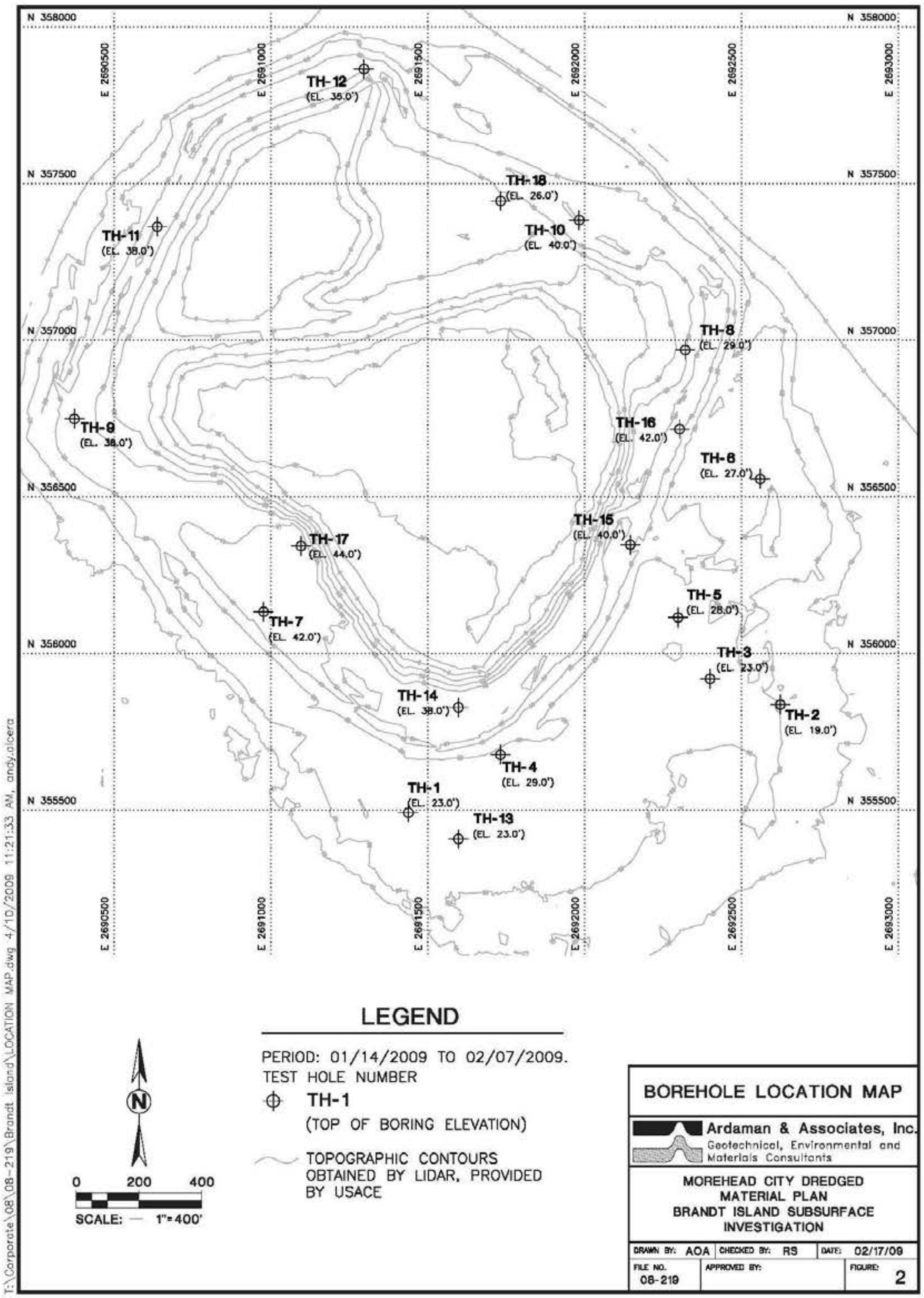


Figure B-5. Soil Boring Locations (with Topographic Contours)

SUBSURFACE CONDITIONS. Based on the boring data, the site consists predominately of sands with interbedded layers of silt. The existing dike material is almost exclusively fine sand material. The foundation below the existing dike is predominately sand, but some areas have layers of silt interbedded throughout the foundation. These silt layers vary in thickness and in strength. There are generally three different foundation conditions at the site.

Conditions encountered at each boring location are indicated on the individual boring logs. Based on the results of the borings, the following three general subsurface conditions exist at the site.

The soil profile at borings TH-2, TH-5, TH-15 and TH16 consist of sands (SP), sands with silt (SP-SM) and silty sands (SM) from ground surface to the termination depths of the borings. Clay was not encountered within these borings except for a thin ½ inch (TH-2 at 8.5'), 2 inch (TH-5 at 5.5') and 2 inch (TH-16 at 29.0') thick seams at the locations.

The soil profile at borings TH-3 and TH-12 consist of sands (SP) and sands with silt (SP-SM) from ground surface to the termination depth of the borings except a thin 6 inch thick layer of very soft fat (CH) clay at depths of 22.5 feet (Elevation 1.5 feet MSL) and 21 feet (Elevation 11.0 feet MSL), respectively.

Twelve of the borings (TH-1, TH-4, TH-6 through TH-11, TH-13, TH-14, TH-17, and TH-18) encountered one or more layers in excess of 1 foot thick of very soft (N<2 blows/foot) to soft (N of 2 to 4 blows/foot) lean (CL) to fat (CH) clay or very loose (N < 4 blows /foot) to loose (N of 4 to 10 blows/foot) clayey sand (SC) within a profile otherwise comprised of sands (SP) to silty sands (SM). The clays and clayey sands typically occurred as 1 to 4.5-foot thick layers within the upper portion of the borings above elevation 14 feet (MSL) or typically below elevation -5 feet (MSL) as 1 to 6-foot thick layers.

The depth to groundwater at boreholes TH-2, TH-3, TH-5, TH-6, TH-7, TH-9, TH-11, TH-14, TH-17 and TH-18 was estimated based on visual observation of the moisture content of the jar samples. The depth to groundwater was measured in borings TH-1, TH-4, TH-8, TH-10, TH-12, TH-13, TH-15 and TH-16 at depths in the range of 3.0 to 12.5 feet below existing ground surface. The specific groundwater depths indicated on the boring logs represent the groundwater surface encountered during drilling on the date shown on the logs. It must be noted that fluctuations in groundwater level will occur due to variations in rainfall, tidal fluctuation, and other factors which may vary from the time the test borings were performed

STABILITY ANALYSIS. A stability analysis is a way to quantify, with a factor of safety, the hazard that a sliding or overturning failure will occur. Specific engineering criteria for the stability analysis dictate the minimum factor of safety, which is typically between 1.3 and 1.5 depending on the case.

A stability analysis was performed on the Brandt Island Dike at the crest elevation of 55 feet.

The software used to perform the analysis was the UTEXAS4 program. UTEXAS4 is a general-purpose software program for limit equilibrium slope stability computations. UTEXAS4 computes a factor of safety, F, with respect to shear strength. The method of analysis used to determine the factor of safety for Brandt Island is Spencer's procedure (Spencer 1967, Wright 1970). Spencer's procedure fully satisfies static equilibrium for each slice within the failure area. Both circular and non-circular failure surfaces are analyzed by the UTEXAS4 software program.

The areas of the alignment were grouped into similar foundations based on the soils data. Three foundation areas were determined based on the subsurface investigation results. Soil properties and strengths were assigned to the foundation layers based on the lab testing results from the subsurface investigation and for areas not tested, and good engineering practice. The soil strength properties for the critical section are show in Table B-3. The stability analysis was performed only on the dike height of elevation 55'. As long as this height is stable, it is assumed that all lower dikes will also be stable. The stability analysis was performed using the Spencer method, which is the preferred method of the USACE, per EM 1110-2-1902 Engineering and Design – Slope Stability. Both circular and wedge failures for each of the three foundation groups were analyzed. Based on the stability analysis results, the dike in the area of boring TH-11 has the weakest foundation and ability to support the dike. Based on the UTEXAS4 stability analysis, the minimum factor of safety for the Brandt Island dike is 1.37. This minimum factor of safety exceeds the minimum required in EM 1110-2-1902 Engineering and Design – Slope Stability criteria of 1.3 for the end of construction case and is acceptable for the elevation 55' dike design. Based on the results of the Stability analysis of the Brandt Island Dike, staged construction will not be required. Using good engineering practice the dikes should be raised no more than 5 feet at a time. By raising the dike in 5 foot intervals the settlement and risk of a stability failure will be minimized.

LAYER	SOIL TYPE	LOCATION	C[1] (psf)	ϕ^2	γ^3 (pcf)
1	Sand	Embankment	0	28	100
2	Sand	Embankment	0	28	100
3	Sand	Embankment	0	30	115
4	Sand	Foundation	0	32	120
5	Sand	Foundation	0	28	115
6	Sand	Foundation	0	32	120
7	Silt	Foundation	800	0	105
8	Sand	Foundation	0	28	110
9	Sand	Foundation	0	30	115
10	Sand	Foundation	0	32	120
11	Silt	Foundation	1300	0	110
12	Sand	Foundation	0	30	115
13	Silt	Foundation	500	0	110
14	Sand	Base	0	32	120

[1]C - Cohesive Strength (psf)
[2]ϕ - Angle of Internal Friction
[3]γ - Unit Weight (pcf)

Table B-3. Soil Strength Properties for the Critical Section

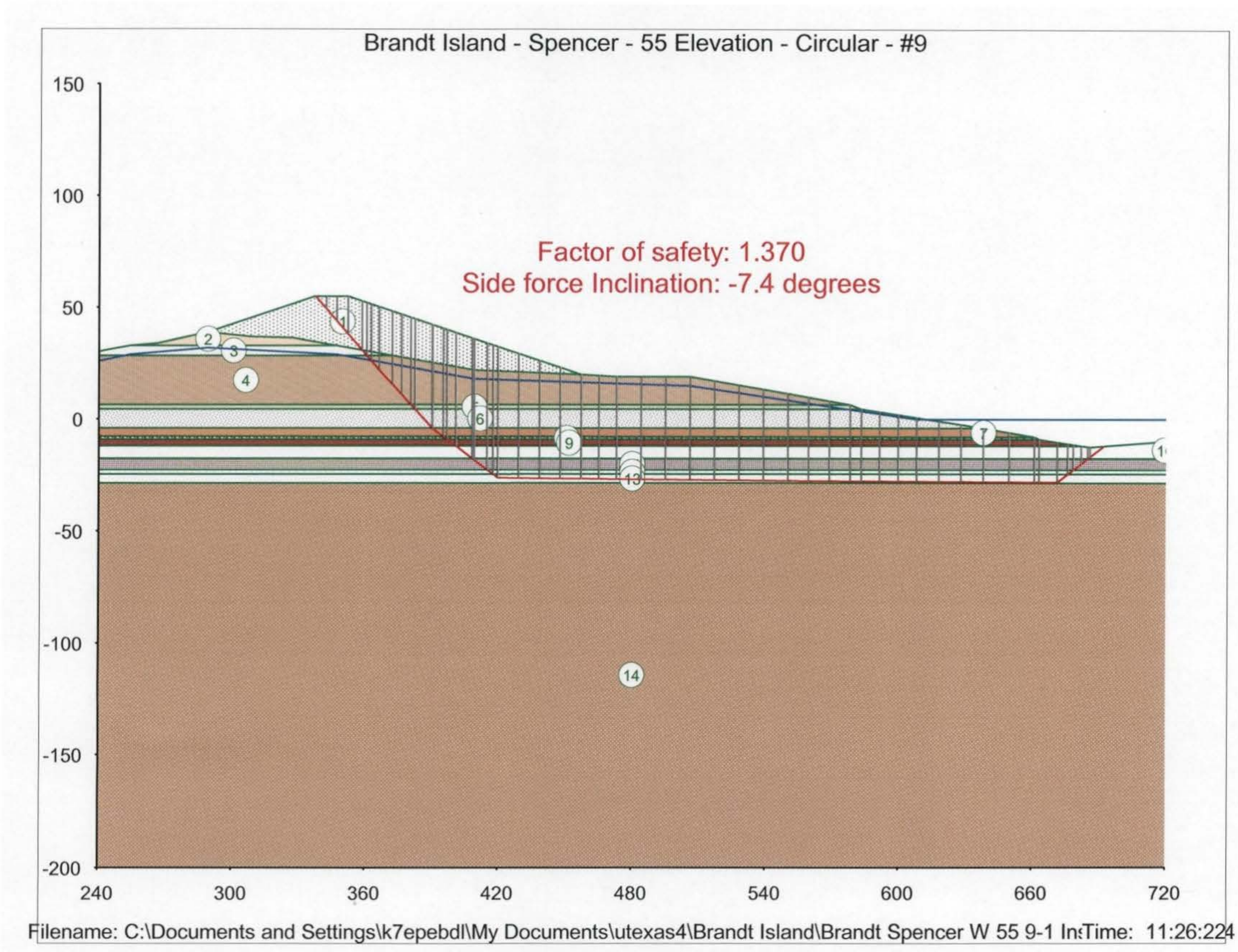


Figure B-6. Stability Analysis Critical Section

New Nearshore Placement Area Soil Analysis

Expansion of the Nearshore West placement area and a new Nearshore East placement area are proposed to provide an additional location for placement of harbor material with up to 20 percent silt/clay. As part of the environmental and cultural investigation performed on the ebb tide delta, 48 soil grab samples were taken on each ebb tide delta, for a total of 96 soil samples were collected in August of 2009. The purpose of these samples was to determine the distribution of the silt content of the ebb tide delta. The samples collected were tested for grain size distribution in accordance with ASTM D 422. The sieves typically used in the testing were the 3/4", 3/8", #4, #7, #10, #14, #18, #25, #35, #45, #60, #80, #120, #170, #200, and #230 sieves. The shell content of each sieve size fraction of each sample was visually estimated to the nearest 5 percent. The estimated total shell content of each sample was calculated using the visually estimated shell content retained on each sieve, the percent dry mass of the sample retained on the sieve, and calculating the weighted average of the full sample. The qualitative amount of shell was described as trace (< 5%), few (5 to 10%), little (15 to 25%), and some (30 to 45%) in accordance with ASTM Standard D 2488. The individual sample test results can be found following this main body of this appendix.

The lowest silt/clay content of a sample was 2A which contained 0.4 percent silt/clay, and the highest silt content in a sample was 90A which contained 61.0 percent silt/clay. The silt/clay content is defined as the percentage of material, by weight, passing the #200 sieve. Out of the 96 sites sampled (USACE 2010b), 21.8 % of the sites contained 10.3 % to 61.0 % silt/clay, and 42.7 %had a low silt/clay content (<2 % silt/clay). Areas of high silt/clay content (>10 % and <61.0 %) were found with one large group of sites occurring principally offshore of Shackleford Banks and several smaller areas offshore of Bogue Banks, in water depths ranging from ~20 to 49 ft. Areas of low silt/clay content (less than <2 % silt/clan content) predominantly were found along the ebb tide delta and along the nearshore of Bogue and Shackleford Banks. A grouping of these stations also occurs offshore in ~40 ft of water. Three large groups of medium silt/clay content (>2 and <10 % silt/clay content) occurred in the mid to nearshore of Shackleford Banks, offshore of the ebb tide delta, and in the mid to nearshore of Bogue Banks.

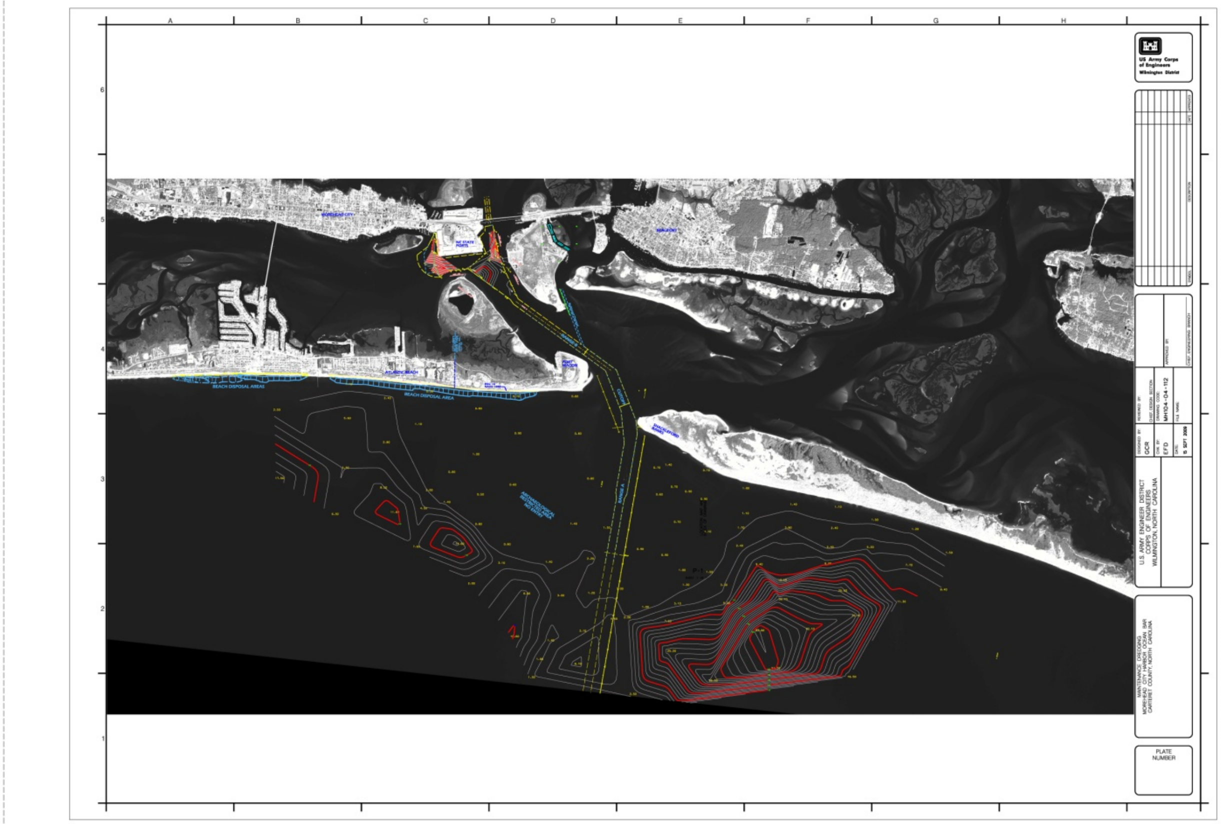


Figure B-7. Nearshore grab sample locations and silt/clay content contours

As shown in Figure B-7, the silt/clay content typically increases from the ebb tide delta to the offshore areas in deeper water depths. The ebb tide delta contains material that is greater than 20 percent silt/clay, and placement of material in this area is expected to redistribute the material to its natural silt/clay content. It is therefore acceptable to place material of 80 percent or greater sand in the nearshore areas.

The primary reasons for the placement of sandy material that is 80 percent or greater sand in both the new nearshore placement areas are as follows:

a. Generally speaking, sediments on the eastern side of the navigation channel have a lower sand content than sediments on the western side, making this side of the channel a more natural fit for sediment with slightly higher silt content.

b. It is the opinion of the USACE, based upon dredging experience, that silt content of dredged material will decrease (and sand content will, as a result increase) as it is placed in a nearshore area and becomes subject to wave and current action.

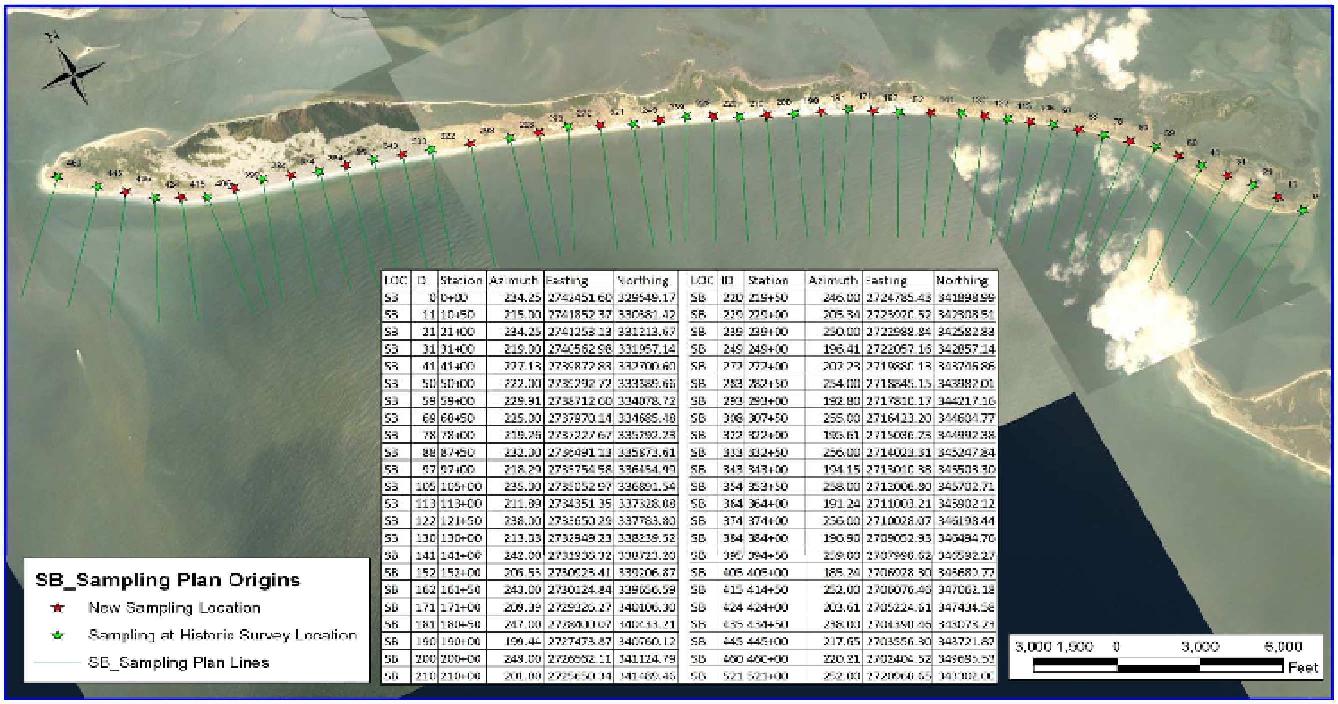
c. From 1995 to the present, the material placed by the USACE in the existing Nearshore West has been at least 90 percent sand. As the USACE monitors material movement on both sides of the channel in the upcoming years, placing only material that is at least 90 percent sand in the Nearshore West will allow for the incorporation of the monitoring that has been conducted from 1995 to the present, and allow meaningful comparisons to be drawn between the two placement areas and their performance. This segregation would also facilitate and more accurate assessment of the health of benthic communities in the vicinity of this placement area.

Creation of a New Disposal Area on Shackleford Banks

The Morehead City Harbor DMMP is considering the disposal of maintenance dredged sediment on the beach of Shackleford Banks. Sampling of Shackleford Banks was performed to document the qualitative values of the native beach prior the disposal of dredged material on the beach. An analysis of the material in the Harbor compared to the native material on Shackleford Banks was performed to assure that the Harbor material is acceptable for disposal on the Shackleford Banks beach.

The sampling locations consisted of 46 transects along the entire length of the beach as shown in Figure B-8. The transects were located at each of the historic survey locations. Additional transects were spaced equally between the historic survey locations so that the spacing is approximately 1000’ between the transects. Fourteen samples were taken along each transect. The sample locations are the dune, dune toe, berm crest, MHW, MSL, MLW, trough, bar crest, -6 MLW, -10 MLW, -12 MLW, -18 MLW, -24 MLW, and -30 MLW as shown on Figure B-9. The sieves used in the grain size testing were the 3/4”, 3/8”, #4, #7, #10, #14, #18, #25, #35, #45, #60, #80, #120, #170, #200, and #230 sieves. An analysis was performed with the grain size results of the samples taken on Shackleford Banks. The % shell content of each sample was determined by estimating visually the amount of shell on each sieve, during the sieve procedure, to determine the overall sample shell content. The color of all samples, both moist and dry, was determined by the Munsell Color System. Key criteria were determined through this analysis. The analysis determined the % coarser than then #4 sieve, the % coarser than then #10 sieve, the % finer than then #200 sieve, the % finer than then #230 sieve, the visual % shell content of the native beach, and the overfill ratio.

Shackleford Banks Sampling Plan Locations



LOC	ID	Station	Azimuth	Easting	Northing	LOC	ID	Station	Azimuth	Easting	Northing
SB	0	0+00	234.25	2742451.60	329549.17	SB	220	219+50	246.00	2724785.43	341898.99
SB	11	10+50	215.00	2741852.37	330381.42	SB	229	229+00	205.34	2723920.52	342308.51
SB	21	21+00	234.25	2741253.13	331213.67	SB	239	239+00	250.00	2722988.84	342582.83
SB	31	31+00	219.00	2740562.96	331957.14	SB	249	249+00	196.41	2722057.16	342857.14
SB	41	41+00	227.13	2739872.83	332700.60	SB	272	272+00	207.23	2719880.13	343745.86
SB	50	50+00	222.00	2739292.72	333389.66	SB	282	282+50	254.00	2718845.15	343982.01
SB	59	59+00	229.91	2738712.60	334078.72	SB	293	293+00	192.80	2717810.17	344217.16
SB	69	68+50	225.00	2737970.14	334685.48	SB	308	307+50	255.00	2716423.20	344604.77
SB	78	78+00	219.26	2737227.67	335292.23	SB	322	322+00	195.61	2715036.23	344992.38
SB	88	87+50	232.00	2736491.13	335873.61	SB	333	332+50	256.00	2714023.31	345247.84
SB	97	97+00	218.29	2735754.58	336454.99	SB	343	343+00	194.15	2713010.38	345503.30
SB	105	105+00	235.00	2735052.97	336891.54	SB	354	353+50	258.00	2712006.80	345702.71
SB	113	113+00	211.89	2734351.35	337328.08	SB	364	364+00	191.24	2711003.21	345902.12
SB	122	121+50	238.00	2733650.29	337783.80	SB	374	374+00	236.00	2710028.07	346198.44
SB	130	130+00	213.03	2732949.23	338239.52	SB	384	384+00	190.90	2709052.93	346494.70
SB	141	141+00	242.00	2731936.32	338723.20	SB	395	394+50	259.00	2707990.62	346592.27
SB	152	152+00	205.53	2730923.41	339206.87	SB	405	405+00	185.24	2706928.30	346680.77
SB	162	161+50	243.00	2730124.84	339656.59	SB	415	414+50	252.00	2706076.46	347062.18
SB	171	171+00	209.39	2729326.27	340106.30	SB	424	424+00	203.61	2705224.61	347434.58
SB	181	180+50	247.00	2728400.07	340433.21	SB	435	434+50	248.00	2704390.45	348078.23
SB	190	190+00	199.44	2727473.87	340760.12	SB	445	445+00	217.65	2703556.30	348721.87
SB	200	200+00	249.00	2726662.11	341124.79	SB	460	460+00	220.21	2702404.52	349685.53
SB	210	210+00	201.00	2725850.34	341489.46	SB	521	521+00	252.00	2720960.65	343102.00

Figure B-8. Shackleford Banks Sample Locations

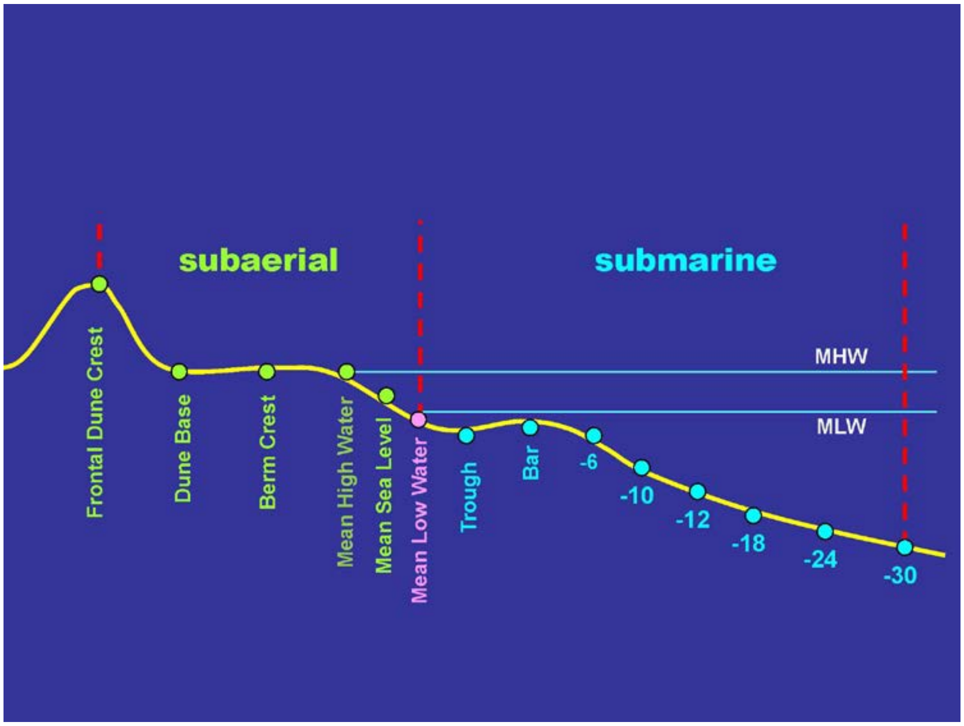


Figure B-9. Shackleford Banks Grab Sample Locations Along Beach Transect

The Shackleford Banks beach was divided into 4 groupings for the grain size analysis. The 4 groupings used in the analysis are the dune to a depth of -24 ft offshore (the approximate depth of closure to wave impact); the dune base to -24 ft; the dune base to MLW; and the beach trough to -24 ft. These groups were chosen for comparison to the Harbor material. The group from the dune to -24 is the condition that most matches the criteria for the “native beach.” The results of the composite analysis were determined by averaging the samples from each grouping.

Between 2005 and 2008 numerous vibracore borings were performed in the Morehead City Harbor Channel to determine the characteristics of dredged materials considered for beach disposal. The Morehead City Harbor ranges where sediments were collected for beach disposal were Ranges A, B, C, and the Cutoff.

Borings designated MIH-05-V-# and MOB-05-V# were vibracore borings performed in 2005. Borings designated MHC-06- # are vibracore borings performed in 2006. These borings are located in Range C. Borings designated MHCOB-07-V-# are vibracore borings performed in 2007. Borings designated MHC-08-V-# are vibracore borings performed in 2008. These borings are located throughout the Morehead City Harbor Channel from range C to Range A. They represent the most comprehensive set of borings performed to date for the identification of material to be dredged. All borings were drilled to a depth below the dredging depth unless vibracore refusal was encountered. Vibracore refusal was defined as a penetration rate of less than 0.1 feet in 10 seconds. Sediment samples taken below the project depth were not included in the analyses.

In all, 130 sediment samples were included in the analyses as described below. All samples within the channel limits to overdepth were tested in accordance with ASTM D 422. The sieves typically used in the testing were the 3/4”, 3/8”, #4, #7, #10, #14, #18, #25, #35, #45, #60, #80, #120, #170, #200, and #230 sieves. Hydrometer analyses were not performed on materials passing the #230 sieve. The results from the analysis of the harbor material were determined by the weighted average of each sample distributed over the length that the samples represents.

The color of the sediment from the Morehead City Harbor channel was not documented to a standard test procedure. However, during the winter of 2010 and 2011, dredged sediment from the Morehead City Outer Harbor was placed on the beaches of Fort Macon State Park to the Town of Atlantic Beach. On April 2011, Wilmington District staff walked the beach disposal areas and determined the color of the sediment by the Munsell Color System. Eighteen (18) transects were sampled from Fort Macon State Park to the circle in the Town of Atlantic Beach. Spacing between transects was about 1,000 feet and 3 dry sediment samples per transect (from the MHW contour, berm crest, and toe of dune) were color coded.

Specific grain size analysis categories and composite approaches are required by the NC Sediment Criteria - Technical Standards for Beach Fill Projects. The categories used in the NC Sediment Criteria are the material less than 0.0625 millimeters, greater than or equal to 0.0625 millimeters and less than 2 millimeters, greater than or equal to 2 millimeters and less than 4.76 millimeters, and greater than or equal to 4.76 millimeters and less than 76 millimeters. The determination of these parameters was performed as part of the analysis to compare the harbor material to the Shackleford Banks beach material.   The use of this criteria is a detailed way to determine if the harbor material is suitable for disposal on Shackleford Banks.

The NC Technical Standards indicate that sediment is compatible for use as beach fill if the following five criteria are met:

a. Fine grained (less than 0.0625 mm) sediment is less than 10%,

b. The average percentage of fine grained (less than 0.0625 mm) sediment is less than 5% greater than that of the recipient beach, and

c. The average percentage of calcium carbonate (% shell) does not exceed 15% of the recipient beach.

d. The average percentage by weight of granular sediment (greater than or equal to 2 mm and less equal to 4.76 mm) in a borrow site shall not exceed the average percentage by weight of coarse sand sediment of the recipient beach characterization plus 5%.

e. The average percentage by weight of gravel (greater than or equal to 4.76 mm) in a borrow site shall not exceed the average percentage by weight of gravel sized sediment for the recipient beach characterization plus 5%.

Based on the analysis of the grain sizes of the sediments of the Morehead City Harbor sediments and the Shackleford Banks sediments, the following is a comparison of the NC Sediment Criteria categories:

a. and b. The Morehead City Harbor sediments contain 3.6% fine grained soil compared to Shackleford Banks sediment containing 1.0% fine-grained soil (passing the #230 sieve (0.063 mm)). The Harbor sediments contain less than 10% fine grain soils and less than 5% greater fine grain sediment compared to the Shackleford Banks sediments. (i.e., 3.6% is less than 6% (1% plus 5% = 6%)).

c. The Morehead City harbor sediment contains 16.0% visual shell. The Shackleford composite (recipient beach) contained 13.9% visual shell. The harbor sediment does not exceed 15% of the recipient beach (i.e., 16.0% is less than 28.9% (13.9% + 15% = 28.9%)).

d. Sediment which is greater (coarser) than or equal to 2 mm and less (finer) than 4.76 mm is the difference between that retained by the # 10 sieve (2.0 mm) and the #4 sieve (4.76 mm). For the Morehead City Harbor sediment the percent passing #4 sieve is 98.1% and passing #10 is 95.4%, a difference of 2.7%. For Shackleford Banks the percent passing the #4 sieve is 96.6% and passing the #10 sieve is 92.5%, a difference of 4.1%. The harbor sediment is LESS THAN 5% of the Shackleford sediment (i.e., 2.7% is less than 9.1% (4.1% plus 5% = 9.1%)).

e. The sieve size of gravel (greater than or equal to 4.76 mm) is greater than the #4 sieve. The Morehead City Harbor sediment percent passing the #4 sieve is 98.1 and Shackleford Banks is 96.6%. That means that the Harbor sediment is 1.9% gravel (100 - 98.1 = 1.9%). Shackleford Banks is 3.4% gravel (100 - 96.6 = 3.4%). Again the harbor sediment is less than 5% of the Shackleford sediment (i.e., 1.9% is less than 8.4% (3.4% plus 5% or 8.4%).

Table B-4 below summarizes information applicable to the NC Sediment Criteria. This table also includes the comparison of the mean and standard deviation of the sediment of the Morehead City Harbor and the sediment of Shackleford Banks. Again the Shackleford Banks Dune to -24 is considered to be the condition that most matches the criteria for the “native beach.”

The mean and standard deviation was calculated in phi units for the Morehead City Harbor sediments and the Shackleford Banks beach sediments. The Morehead City

Harbor sediments' mean was calculated as 1.90 phi (.27 mm). The Shackleford Banks Beach sediments' mean was calculated as 1.56 phi (.34 mm). This shows that the Morehead City Harbor sediment is slightly finer than the Shackleford Banks beach sediment. The standard deviation of the Morehead City Harbor sediments was calculated as .84 phi and the standard deviation of the Shackleford Banks sediments was calculated as 1.13 phi. See Table B-1.

Based on the sediment analysis, the Morehead City Harbor maintenance sediment meets the North Carolina compatibility criteria for disposal on Shackleford Banks. The histogram in Figure B-10 compares the distribution of the 4 groups of Shackleford Banks sediments to the Morehead City Harbor sediments.

	SAMPLES	MEAN (phi)	STD DEV (phi)	% PASSING #4	%PASSING #10	% PASSING #200	% PASSING #230	% VISUAL SHELL
	-	-	-	-	-	-	-	-
Morehead City Outer Harbor	**130**	**1.90**	**0.84**	**98.1**	**95.4**	**3.6**	**3.6**	**16.0**
Shackleford Banks Native Data DN to -24	**598**	**1.56**	**1.13**	**96.6**	**92.5**	**1.2**	**1.0**	**13.0**
Shackleford Banks Native Data DB to -24	**552**	**1.54**	**1.20**	**96.3**	**91.9**	**1.3**	**1.0**	**13.9**
Shackleford Banks Native Data DB to MLW	**230**	**0.91**	**1.29**	**94.2**	**87.1**	**0.4**	**0.4**	**22.2**
Shackleford Banks Native Data TR to -24	**322**	**2.00**	**0.88**	**97.8**	**95.3**	**1.9**	**1.5**	**8.0**

Table B-4. Grain Size Comparison of NC Sediment Criteria Results

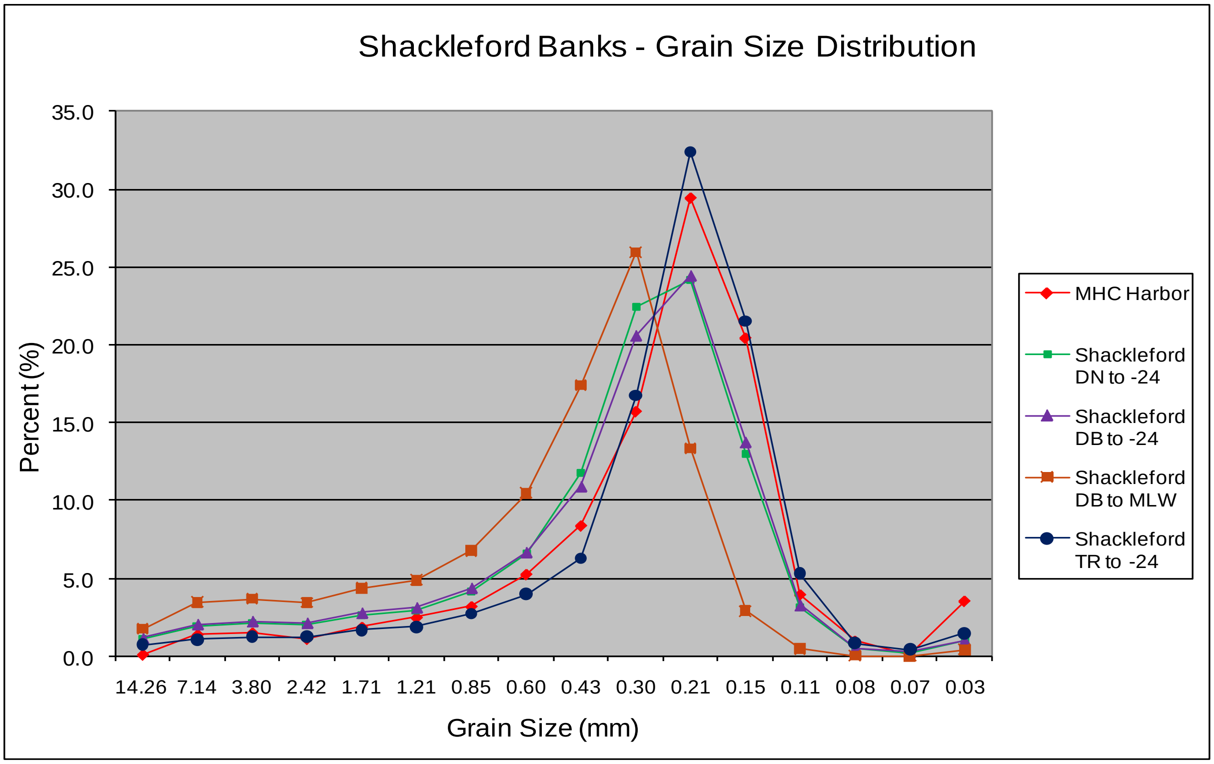


Figure B-10. Grain Size Distribution for Shackleford Banks and Harbor Soils

The suitability of the borrow material for disposal on the beach is based on the overfill ratio. The overfill ratio is computed by numerically comparing the size distribution characteristics of the native beach sand with that in the borrow area and includes an adjustment for the percent of fines in the borrow area. The overfill ratio is primarily based on the assumption that the borrow material will undergo sorting and winnowing once exposed to waves and currents in the littoral zone, with the resulting sorted distribution approaching that of the native sand. Since borrow material will rarely match the native material exactly, the amount of borrow material needed to result in a net cubic yard of beach fill material will generally be greater than one cubic yard. The excess material needed to yield one net cubic yard of material in place on the beach profile is the overfill ratio. The overfill ratio is defined as the ratio of the volume of borrow material needed to yield one net cubic yard of fill material. For example, if 1.5 cubic yards of fill material is needed to yield one net yard in place, the overfill factor would equal 1.5. (SPM)

The overfill criteria developed by James (1975) is the method used in the Automated Coastal Engineering System (ACES). The procedure is also described in the U.S. Army Coastal Engineering Manual (CEM) EM-1110-2-1100 Part V (July 2003).

The Dean's equilibrium method (Dean, 1991) determines the volume of recharged sand of a given grain size to increase the width of dry beach by a given amount. Dean proposed that beach profiles develop a characteristic parabolic equilibrium profile. (CEDD)

The equilibrium slope method by Pilarczyk, van Overeem and Bakker (1986) bases the recharged profile on the present native profile. However, if the grain size of the fill material is different from the native material, the profile steepness is altered. (CEDD)

The Krumbein and James Method is only applicable if the native material is better sorted than the fill material. If the fill material is better sorted than the native material, this method simply does not apply. Secondly, the Krumbein and James Method assumes that the portion of the fill material retained on the beach after sorting by waves and current will have exactly the same size distribution of the native material. This implies that both the fine and coarse portion of the fill will be lost. This feature is not consistent with the knowledge of sediment transport process as the coarser portion of the fill will likely remain on the beach without being carried away by waves and currents (Dean, 1974; also Dean and Dalrymple, 2002). The overfill ratio by the Krumbein and James Method will tend to be overestimated. Dean (1974) addressed the above shortcomings by assuming that only the finer portion of the fill will be winnowed away by prevailing wave condition leaving the mean diameter of altered distribution of fill material to be at least as large as the mean diameter of native material. Dean defines the overfill ratio as the required replacement volume of fill material to obtain one unit of compatible beach material and uses the ‘phi’ unit to describe the size of sand particle. (CEDD)

Krumbein and James (1965) established a method for estimating the additional quantity of fill material required if the fill and native sediment are dissimilar. The method involved multiplying the required volume of beach material, assuming a natural grading, by a critical overfill ratio R_{crit} to determine the quantity of fill material over and above that required by the absolute dimensions of the proposed nourishment works. (CEDD)

The overfill ratio for the Shackleford Banks Beach compared to the Morehead City Inner Harbor material was calculated by all 5 methods. The group from the dune to -24 is the most condition that most matches the criteria for the “native beach.” For the overfill calculation results, see Table B-5 below. The Equilibrium Profile Method (EPM) is considered to be the most accurate method base in it taking into consideration the shape of the fill and the significant wave height. Based on the EPM, the overfill ratio for is 1.22. Any value of less that 1.5 is considered acceptable for use as beach renourishment. It should be pointed out that this is not a renourishment project, but that the material meets the stringent requirements for soils to be used for a renourishment project.

	MEAN (phi)	STD DEV (phi)	ACES	Overfill Ratio Assumed: Berm Height=6' Berm Width=150' Significant Wave Height=6.2' EPM	ESM	Dean Method	K and J Method
Morehead City Outer Harbor	- 1.90	- 0.84	NA	NA	NA	NA	NA
Shackleford Banks Native Data DN to -24	- 1.56	- 1.13	2.353	1.22	1.49	1.1	0.672

ACES - Automated Coastal Engineering System
EPM - Equilibrium Profile Method
ESM - Equilibrium Slope Method
K and J - Krumbein and James Method

Table B-5. Shackleford Banks Overfill Ratios

REFERENCES

JAMES, W.R., "Techniques in Evaluating Suitability of Borrow Material for Beach Nourishment," TM-60, Coastal Engineering Research Center, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Miss., Dec. 1975.

CIRIA (1996). Report 153 – Beach Management Manual. Construction Industry Research and Information Association, United Kingdom, 448p.

Dean, R.G. (1974). Compatibility of Borrow Material for Beach Fills. Proceedings of the 14th International Conference on Coastal Engineering, ASCE, Copenhagen, pp. 1319-1333.

Dean, R.G. (1991). Equilibrium beach profiles : Characteristics and applications. Journal of Coastal Research, Volume 7, No. 1, pp. 53-84.

Dean, R.G. and R.A. Dalrymple (2002). Coastal Processes with Engineering Applications. Cambridge University Press, 475p.

Krumbein, W.C. and James, W.R. (1965). A log-normal size distribution model for estimating stability of beach fill material. Technical Memorandum No. 16, Coastal Research Centre, US Army Corps of Engineers.

Pilarczyk, K.W., Van Overeem, J. and Bakker, W.T. (1986). Design of beach nourishment scheme. Proceedings 20th International Conference on Coastal Engineering, Taiwan.

APPENDIX C

SHOALING ANALYSIS

Historic Shoaling Rates

Purpose: The purpose of the shoaling analysis section of this report is to determine the average amount of material that is shoaling into the navigation channel at Morehead City Harbor on an annual basis. The Morehead City Harbor navigation channel is broken into six major ranges as follows:

- Range A
- Cutoff
- Range B
- Range C / East Leg
- West Leg
- Northwest Leg

These ranges are then separated based on the quality of material contained within each area (figure 1). Ranges that contain coarse-grained (≥90 percent sand) which is suitable for beach disposal include: Range A out to station 110+00; the Cutoff; Range B; and a portion of Range C/East Leg from the seaward extent through station 17+00. Ranges containing fine-grained (<90 percent sand) material include: Range A from station 110+00 seaward; Range C/East Leg from station 17+00 landward; the West Leg; and the Northwest Leg. Beach compatibility is based on the most recent boring log information taken from each range and is discussed in detail within the Geotechnical Appendix of this report.

Shoaling rates for the given ranges can be used to estimate several future needs with regard to disposal/placement areas, to include ensuring sufficient volume is available for the estimated disposal quantities. Also, the rates can be used to determine disposal island pumpout frequencies as well as estimate quantities available for beach disposal of acceptable sand material.

Historical Data: The basis for the shoaling study is the historical surveys collected and maintained by the Wilmington District Navigation section. The entrance channel, ocean bar, and inner harbor are surveyed on a regular basis to ensure proper depth is maintained. In addition to these condition surveys, the channel is also surveyed just prior to and immediately after dredging events. These historic surveys were collected and imported into a new diagnostic modeling tool as part of a demonstration project by Taylor Engineering (Carvalho and Albada, 2006). The focus of the tool is to provide a useful way to monitor shoal rates within navigation channels. As part of the demonstration project, surveys were processed through 2005. The remainder of the surveys through 2007 were collected and processed by the Wilmington District Coastal Engineering section as part of this shoaling calculation effort.

Assumptions: Several assumptions were made for the calculation of channel shoal rates prior to beginning the work. They are as follows:

- First, the analysis is based on a comparison of bathymetric surveys only. Due to time constraints, a comparison of the surveys to the dredging template was not made.
- Partial surveys were included in the comparison with the assumption that the survey covered all areas within the channel that may have shoaled. Surveys that were very small in coverage area were excluded.
- All comparisons were made within the lateral bounding limits of the channel polygon. Any dredging that may have occurred outside the authorized channel lateral limits was not considered. Dredging volume that occurred within the lateral limits of the authorized channel that was below the authorized depth was included in the analysis.
- Shoaling rates were generally limited to between the years 2000 and 2007 due to funding and time limitations.

<u>Methods and Results:</u> As discussed earlier, the Diagnostic Modeling System ESRI extension was used to compute volumetric changes between surveys. Change values were computed between surveys and categorized four ways: condition survey to before dredge survey; after dredge to before dredge survey; after dredge to condition survey; and before dredge to after dredge survey. In the absence of a valid before or after dredge survey for a given time period, the condition survey closest to the date of the missing survey would be used as a substitute to measure trends.

Once volume differences were computed between survey events they were sorted to group similar survey dates. Survey comparisons between common dates, i.e. two different condition surveys compared to the same before dredge survey, would have their individual shoal rates averaged to produce one shoal rate that represented this time period. Once all shoal rates were computed the average shoal rate for the type of comparison, i.e. after dredge to condition, would be computed. This would ultimately produce three shoal rates, one each for the after dredge to condition, the condition to before dredge, and the after dredge to before dredge. These three rates would then be averaged into what is used as the representative shoal rate for a particular section of the channel. Final shoaling rates for each section of the navigation channel are shown in Table 1.

<u>Historic Dredge Volumes:</u>

<u>Purpose:</u> In an attempt to correlate the newly developed shoaling rates with the amount of material historically dredged from the channel, an average annual dredging rate was developed based on the historic dredge volumes.

<u>Historic Data:</u> The navigation channel and inner harbor was broken into six regions based on historic dredging contracts between 1997 and 2008, as follows:

- Range A
- Cutoff

- Range B
- Range C / East Leg
- West Leg
- Northwest Leg

Unlike shoaling rates developed previously using the actual survey data, these data were not separated into beach quality material and non-beach quality material. This was due to the limited nature of the available contract data which typically only includes channel quantities for before dredge and after dredge conditions, as well as the overdepth volume. Overdepth volume is material dredged beyond the authorized channel template and is subtracted from the volume calculated based on the before dredge and after dredge surveys. This final pay quantity was used as the basis for developing the average annual dredging rates for historic dredging.

Methods and Results: Actual pay volume quantities were organized into one of the six regions described above by survey date. Due to the variability of the number of dredging events for each reach and the time between surveys, an average was computed for both the dredge volume and duration between events. These average values were then used to compute the average annual dredging rate by dividing the average volume dredged by the average duration between dredging events. A summary of the results is shown in table 1.

To make comparisons between the shoaling rate and the average annual dredging rate calculations, ranges for the survey based shoaling rates had to be combined into the six ranges used in the dredging rate analysis. The last column in table 1 shows the substantial difference in the two calculation methods. There are multiple explanations for the differences observed between the two methods. The first reason for the difference is that the average annual dredging rate does not include material dredged from outside the channel template as a result of it being based on pay quantities only. Secondly, material that shoals into the navigation channel during the dredging process is unaccounted for in the pay quantities. The period of time that a contractor occupies a section of the navigation channel for dredging varies, but can range between four to eight weeks for a typical section. Since contracts are typically paid based on material removed between after dredge and before dredge surveys, the contractor must remove the amount specified in the construction contract and shoaling during construction as well. For example, an eight week dredging operation would remove roughly 17 percent of anticipated yearly shoaling which would not be represented in the final quantity. The third reason for shoaling rates to be higher than average annual dredging rates would be that previous dredging events may have not removed all shoaling within the channel. Shoaling that occurs within the channel, but does not restrict navigation may not be removed until such point that it becomes a navigational issue. Also, shoaling has occurred in areas such as the Shackleford Banks spit at the intersection of Range A and the Cutoff where the typical hopper dredging plant is unable to dredge the navigation channel to its full alignment. Lastly, maintenance of the project is frequently limited by funding.

Given these differences, the most reliable tool to predict shoaling volumes within the channel would be the survey based shoaling rates applied over the anticipated period between dredging events.

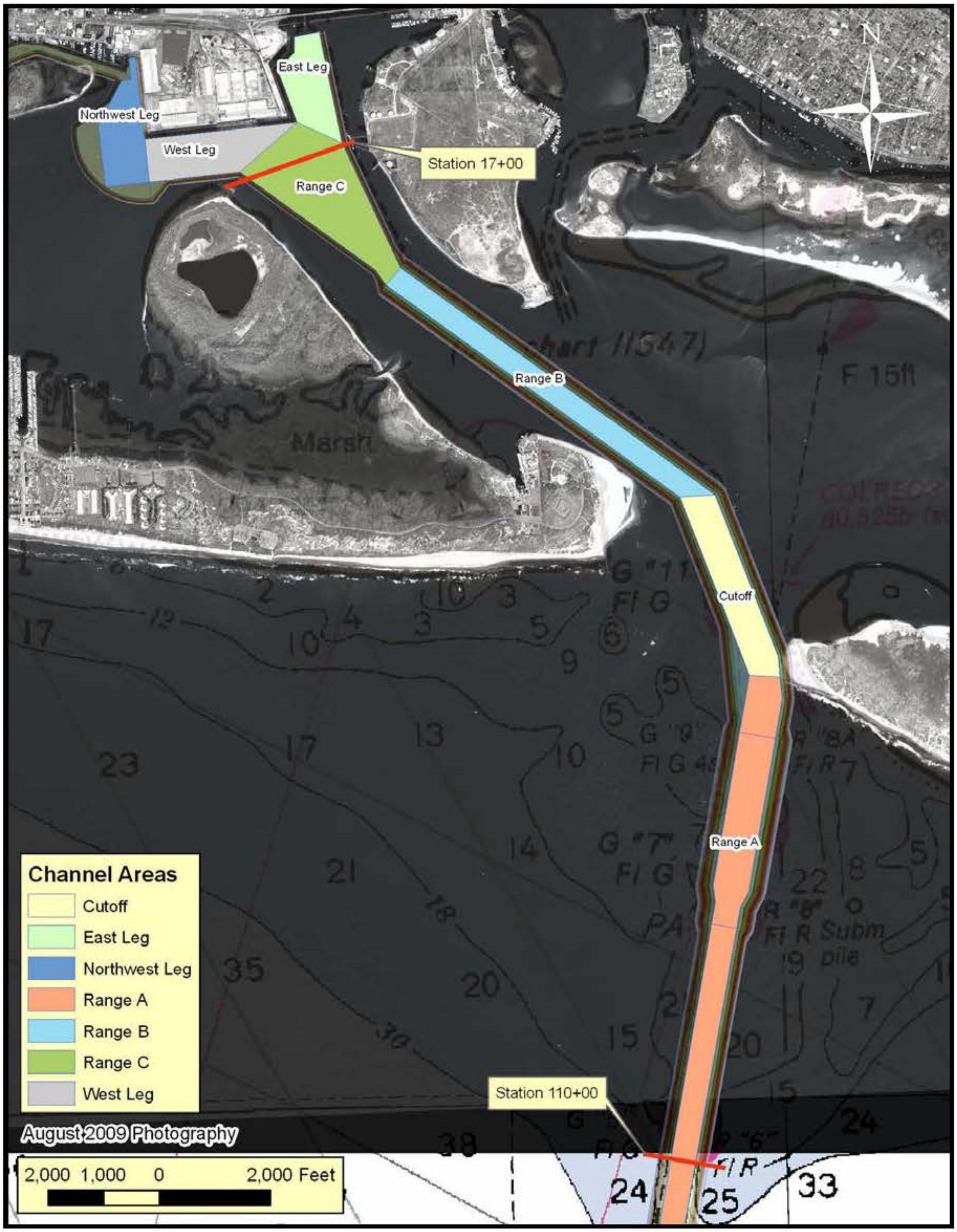


Figure 2

	Shoaling Rates Based on Survey Comparison (AD, BD, and Condition Surveys 2000-2007)				Average Annual Dredging Rates (1997 - 2008)		
Range	Representative Shoaling Rate (C.Y./Year)	Shoaling Rate (C.Y./day)	Combined Shoaling Rate (C.Y./Year)	Combined by Range (C.Y./Day)	Representative Dredging Rate (C.Y./Year)	Dredging Rate (C.Y./day)	% Difference
Range A Suitable	630,500	1,727					
Range A Unsuitable	118,500	325	749,000	2,052	547,600	1,500	-26.89%
Range B	170,000	466	170,000	466	45,400	124	-73.29%
Cutoff	324,500	889	324,500	889	182,500	500	-43.76%
Range C Eastleg Suitable	80,500	221					
Range C Eastleg Unsuitable	86,000	236	166,500	456	138,200	379	-17.00%
West Leg	28,000	77	28,000	77	23,200	64	-17.14%
Northwest Leg	80,000	219	80,000	219	60,900	167	-23.88%

Table 1

Reference:

Carvalho, Alexandra, Ph.D. and Edward Albada, P.E., 2006. "Morehead City Harbor DMS Data Manager Application Carteret County, North Carolina", Taylor Engineering, Jacksonville, FL.

APPENDIX D

PUBLIC AND AGENCY CORRESPONDENCE

November 26, 2007

Environmental Resources Section

Dear Sir or Madam:

The U.S. Army Corps of Engineers, Wilmington District, is initiating work on the Morehead City Harbor Dredged Material Management Plan (DMMP). The purpose of the DMMP is to address long-term (20-year) management of the dredged material from Morehead City Harbor, (see enclosed map). The DMMP studies will involve data collection, compilation, analyses, evaluations, surveys, mapping, coordination, and management necessary to address the major alternatives and to coordinate a DMMP report. We plan on completing the DMMP process in two years.

At this time we are inviting your participation in project planning through the scoping process and are requesting comments from agencies, interest groups, and the public to identify significant resources, issues of concern, and recommendations for studies considered necessary. Comments received during the scoping process will be considered as we conduct our studies and identify dredged material disposal alternatives and evaluate them from engineering, economic, and environmental perspectives. These items will be addressed in the DMMP and likely in a National Environmental Policy Act (NEPA) document. The document, if necessary will be prepared in accordance with the Council on Environmental Quality and the Corps of Engineers regulations for implementing the National Environmental Policy Act of 1969, as amended. The purpose of the NEPA document is to ensure that the environmental consequences of managing the disposal of dredged material removed from the navigational channels are considered and environmental and project information is available to the public.

A scoping meeting is planned for a later date in Morehead City, North Carolina. We will present the Morehead City Harbor DMMP objectives and elaborate on measures being considered.

Written comments are presently requested to help us identify significant issues that should be addressed during the preparation of the DMMP and any associated NEPA document. Please provide your comments within 45 days from the date of this letter so that they may be considered during our evaluations and decisions process. Early identification of issues will facilitate our ability to address them in our studies. Comments should be addressed as follows:

U.S. Army Corps of Engineers,
Wilmington District
Attention: Mr. Stacy Samuelson (CESAW-TS-PE)
Post Office Box 1890
Wilmington, North Carolina 28402-1890

CESAW-TS-PE/Samuelson

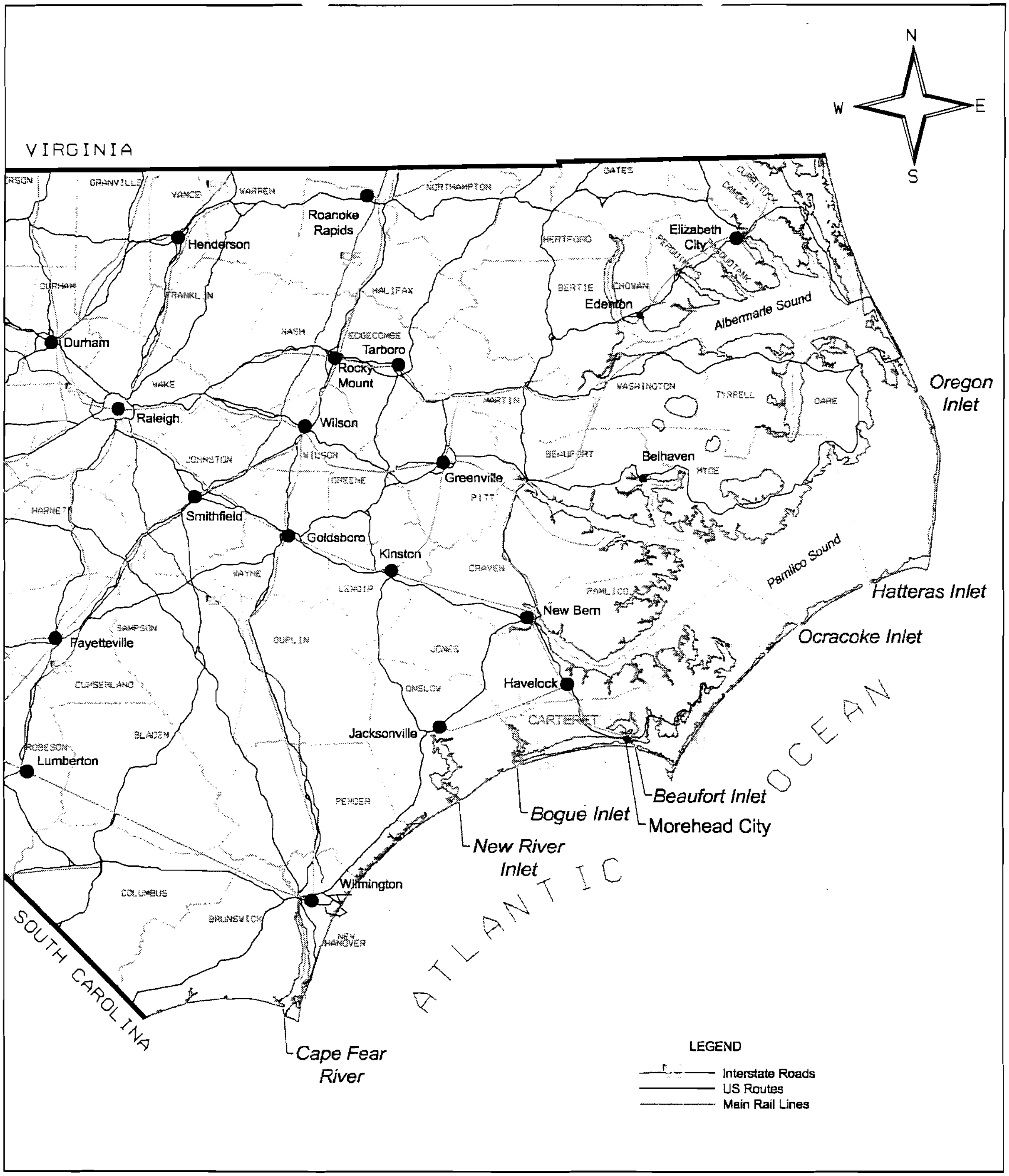
If you have any questions concerning this matter, please call Mr. Stacy Samuelson, Environmental Resources Section, at (910) 251-4480 or email Stacy.D.Samuelson@usace.army.mil. If you would like to be informed of the date and location of the scoping meeting please let Mr. Samuelson know so that we can provide the pertinent information.

Sincerely,

W. Coleman Long
Chief, Planning and Environmental Branch

Enclosure

CESAW-TS-PE/Samuelson
CESAW-TS-PE/Payonk
CESAW-PM-Blount
CESAW-OC/McCorcle
CESAW-TS-P/Long/s
Return to Brenda Willett
Mail
Mailing List will be EIS Standard, Carteret County



0 15 30 MILES

SCALE: 1" = 30 MILES

EXHIBIT 1.1
LOCATION MAP

MOREHEAD CITY VICINITY

North Carolina
Department of Administration

Michael F. Easley, Governor | Britt Cobb, Secretary

November 30, 2007

Mr. W. Coleman Long
U.S. Army - Corp of Engineers
Wilmington District
P.O. Box 1890
Wilmington NC 28402-1890

Dear Mr. Long:

Subject: Scoping - Development of the Morehead City Harbor Dredging Material Management Plan (DMMP) to address long-term (20-year) management of the dredged material from Morehead City Harbor in Carteret County.

The N. C. State Clearinghouse has received the above project for intergovernmental review. This project has been assigned State Application Number 08-E-0000-0157. Please use this number with all inquiries or correspondence with this office.

Review of this project should be completed on or before 01/14/2008 . Should you have any questions, please call (919)807-2425.

Sincerely,

Chrys Baggett

Ms. Chrys Baggett
Environmental Policy Act Coordinator

cc: Mr. Stacy Samuelson

Mailing Address:
1301 Mail Service Center
Raleigh, NC 27699-1301

Telephone: (919)807-2425
Fax (919)733-9571
State Courier #51-01-00
e-mail: Chrys.Baggett@ncmail.net

Location Address:
116 West Jones Street
Raleigh, North Carolina

NCDENR
North Carolina Department of Environment and Natural Resources
Division of Marine Fisheries
Michael F. Easley, Governor
William G. Ross Jr., Secretary
Dr. Louis B. Daniel III, Director

December 20, 2007

US Army Corps of Engineers
Wilmington District
Attention: Mr. Stacy Samuelson (CESAW-TS-PE)
PO Box 1890
Wilmington, NC 28402-1890

Dear Mr. Samuelson:

The North Carolina Division of Marine Fisheries (DMF) would like to offer the following comments concerning development of the Morehead City Harbor Dredged Material Management Plan (DMMP).

The North Carolina Coastal Habitat Protection Plan (CHPP) which was developed through the efforts of staff from DMF, NC Division of Coastal Management, NC Division of Water Quality, NC Wildlife Resources Commission, and NC Division of Environmental Health and adopted by the NC Marine Fisheries Commission, NC Environmental Management Commission and NC Coastal Resources Commission makes the following recommendations concerning studies necessary for the proper use of dredge material for beach renourishment:

1. Identify more specific minimum and maximum sediment grain sizes to minimize biological impacts to the intertidal beach community.

2. Determine the minimum distance required between undisturbed areas within/bordering the renourishment project to provide adequate sources of intertidal organism for recolonization and food for fish.

3. Determine the time interval between projects to allow full recovery of benthic communities based on project season/duration, compatibility of sediment size and other parameters.

The CHPP also contains the following recommendations concerning beach renourishment projects:

1. Restrict beach nourishment projects to winter months to minimize mortality of infauna and enhance recovery rates of intertidal benthic organisms.

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2. Conduct adequate monitoring of the effects of beach nourishment on the soft bottom community and associated surf fish populations.

The NC Marine Fisheries Commission has also established the following general policies related to large-scale beach dredge-and-fill projects:

1. Projects should fulfill the Commission's general habitat policy by avoiding, minimizing and offsetting damage to the marine and estuarine resources of North Carolina;

2. Projects should provide detailed analyses of possible impacts to each type of essential Fish habitat (EFH), with careful detailed analyses of possible impacts to Habitat Areas of Particular Concern (HAPC) and Critical Habitat Areas (CHA), including short and long term, and population and ecosystem scale effects;

3. Projects should provide a full range of alternatives, along with assessments of the relative impacts of each on each type of EFH, HAPC, and CHA;

4. Projects should avoid impacts on EFH, HAPCs and CHAs that are shown to be avoidable through the alternative analysis, and minimize impacts that are not;

5. Projects should include assessments of potential unavoidable damage to marine resources, using conservative assumptions;

6. Projects should be conditioned on the avoidance of avoidable impacts, and should include compensatory mitigation for all reasonably predictable impacts to the marine and estuarine resources of North Carolina, taking into account uncertainty about these effects. Mitigation should be local, up-front and in-kind wherever possible;

7. Projects should include baseline and project-related monitoring adequate to document pre-project conditions and impacts of the projects on the marine and estuarine resources of North Carolina;

8. All assessments should be based upon the best available science, and be appropriately conservative so as to be prudent and precautionary; and

9. All assessments should take into account the cumulative impacts associated with other beach dredge and-fill projects in North Carolina and adjacent states, and other large-scale coastal engineering projects that are ecologically related.

Thank you for the opportunity to comment on development of the DMMP. Please inform DMF of the date and location of the scoping meeting.

Sincerely,

Michael D. Marshall
Central District Manager

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

DEC 1 3 2007

Mr. Stacy Samuelson (CESAW-TS-PE)
U.S. Army Corps of Engineers
Wilmington District
P.O. Box 1890
Wilmington, North Carolina 28402-1890

Dear Mr. Samuelson:

This letter is in response to your request for comments to the initiation of work on the Morehead City Harbor Dredged Material Management Plan (DMMP), dated November 26, 2007. The U.S. Environmental Protection Agency (EPA), Region 4 wants to ensure that throughout the development of the DMMP, all matters related to ocean disposal of dredged material and proper management and monitoring of the Morehead City Ocean Dredged Material Disposal Site (ODMDS) are adequately addressed and coordinated with EPA.

Should you have any questions or reach the point where ocean dumping specifics need to be identified, please contact Mr. Gary Collins of my staff at 404/562-9395. I ask that you also inform Mr. Collins of the date and location of the scoping meeting, as well as any other important meetings related to this matter.

Sincerely,

Thomas C. Welborn, Chief
Wetlands, Coastal and Nonpoint Source Branch

NCDENR

North Carolina Department of Environment and Natural Resources
Division of Parks and Recreation

Michael F. Easley, Governor William G. Ross Jr., Secretary Lewis R. Ledford, Director

January 28, 2008

U.S. Army Corps of Engineers,
Wilmington District
Attention: Mr. Stacy Samuelson (CESAW-TS-PE)
Post Office Box 1890
Wilmington, North Carolina 28402-1890

Dear Mr. Samuelson:

It is good to hear that the U.S. Corp of Engineers will be completing a Morehead City Harbor Dredged Material Management Plan (DMMP) within the next two years. This type of study is needed, and I hope Fort Macon can have some input into the plan.

As you may know, Fort Macon State Park has started receiving material from the Morehead City Inner Harbor, and it has been placed on the shoreline of Ft. Macon State Park in the vicinity of the bathhouse structures. We hope to continue to receive this placement of material in the future. Please keep me informed of any meetings that are planned for the DMMP.

Sincerely,

Jody Merritt

Jody Merritt, Park Superintendent
Fort Macon State Park
PO Box 127
Atlantic Beach, NC 28512

Fort Macon State Park, PO Box 127, Atlantic Beach, NC 28512
Phone: 252-726-3775 • FAX: 252-726-2497 • Email <Fort.Macon@ncmail.net>

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Samuelson, Stacy D SAW

From: Bouchard, Jennifer A LT CNRMA [jennifer.bouchard@navy.mil]
Sent: Monday, December 10, 2007 12:12 PM
To: Samuelson, Stacy D SAW
Subject: Morehead City Harbor DMMP

Mr. Samuelson,

Good afternoon, Sir. I have just recently taken over as Officer in Charge, Navy Port Control in Morehead City. This morning I received an email with the complaint filed against the US Army Corps of Engineers by Carteret County. Of course our concern is the future inability of Navy Ships to enter the harbor safely for Marine on load and off load if the dredging is not able to be conducted. If possible I would like to attend the scoping meeting. Will you send me the date, time, and location of the meeting. Thank you for your assistance.

Very Respectfully,
LTJG Jennifer Bouchard
OIC Navy Port Control Morehead City, NC
113 Arendell St #114 Morehead City, NC 28557
Office: (252) 726-1976 Cell: (252) 241-8498 Fax: (252) 726-7693
NIPR E-mail: jennifer.bouchard@navy.mil
SIPR E-mail: mowreywc@2mawcp.usmc.smil.mil
gutierrezgd@2mawcp.usmc.smil.mil

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United States Department of Agriculture

NRCS

Natural Resources Conservation Service
4405 Bland Road, Suite 205
Raleigh, North Carolina 27609

Phone: (919) 873-2134
Fax: (919) 873-2154
Email: mike.hinton@nc.usda.gov

December 4, 2007

Mr. Stacy Samuelson
CESAW-TS-PE
USACOE-Wilmington District
P. O. Box 1890
Wilmington, NC 28402-1890

Dear Mr. Samuelson:

Thank you for the opportunity to provide comments on Morehead City Harbor Dredged Material Management Plan (DMMP), Carteret County, North Carolina.

The Natural Resources Conservation Service does not have any comments at this time.

If you need additional information, please feel free to contact me at (919) 873-2134.

Sincerely,

Michael J. Hinton
Planning Specialist

North Carolina Department of Cultural Resources
State Historic Preservation Office
Peter B. Sandbeck, Administrator

Michael F. Easley, Governor
Lisbeth C. Evans, Secretary
Jeffrey J. Crow, Deputy Secretary

Office of Archives and History
Division of Historical Resources
David Brook, Director

February 1, 2008

Stacy Samuelson
US Army Corps of Engineers
PO Box 1890
Wilmington, NC 28402-1890

Re: Morehead City Harbor Dredging Materials Management Plan, Morehead City, Carteret County, CH 07-2621

Dear Mr. Samuelson:

Thank you for your letter of November 30, 2007, concerning the above project.

There are numerous National Register-listed properties within the project area described in your scoping letter. These need to be considered for inclusion in your report.

Furthermore, the Dredging and Disposal of Materials from Morehead City Harbor has potential to impact the National Register Historic Property, Queen Anne's Revenge, 31CR314, as well as known and unknown sites in the vicinity. These properties and potential impacts should be considered throughout the planning stage.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, contact Renee Gledhill-Earley, environmental review coordinator, at 919-807-6579. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Renee Gledhill-Earley
Peter Sandbeck

cc: State Clearinghouse

MOREHEAD CITY
NORTH CAROLINA PORTS
WILMINGTON

Rex Edwards
Director of Operations
Port of Morehead City

January 3, 2008

Mr. Stacy Samuelson (CESA W-TS-PE)
Wilmington District, U.S. Army Corps of Engineers
P.O. Box 1890
Wilmington, NC 28402-1890

Dear Mr. Samuelson:

The North Carolina State Ports Authority submits the comments below in response to your letter dated November 26, 2007, requesting comments and recommendations on initiation of a Morehead City Harbor Dredged Material Management Plan (DMMP) and studies considered necessary to identify and evaluate dredged material disposal alternatives. The Authority's position focuses on the economic benefits that the Port provides to the Morehead City community, the State of North Carolina, and the United States, while expressing support for incorporation of beneficial use of dredge materials in the Corps' policy and practices.

1. The Authority is deeply concerned about any action that would prevent dredging projects required to maintain the Morehead City Harbor navigation channel from safely accommodating transit by commercial vessels that use the state Port of Morehead City, vessels that serve the interests of national defense, and other craft used in maritime related business and recreational activities to the benefit of businesses, industry, and the citizens of North Carolina.

2. Failure to maintain full project channel dimensions in Morehead City would seriously jeopardize the Authority's ability to serve our current customer base, as well as hamper our efforts to secure new business. Cargo handling activities at the state Port support nearly 13,000 statewide jobs and $49 million dollars in local and state tax revenues that would be in jeopardy.

3. The Port of Morehead City partners with the Department of Defense, serving as one of the nation's 15 strategic ports for national defense – providing a platform for wartime and peacetime overseas military deployment of military personnel and equipment used to support our national defense efforts.

4. The Authority supports regional dredged material management. A DMMP and supporting studies are essential tools for demonstrating alternatives, risks, and benefits within a watershed.

5. The Authority fully supports development of a DMMP for Morehead City Harbor and any funding needed to expedite this plan.

6. The Port of Morehead City serves as a gateway to world markets for North Carolina's businesses, industries, and citizens. Products handled at the Port include phosphate used for fertilizers, lumber, natural rubber, scrap metal, and ore used to fabricate fiberglass. These commodities come from or are shipped throughout the world, particularly India, Venezuela, Brazil, China, and Indonesia.

7. Examples of regional and statewide economic benefits are:
   a. Morehead City's longtime and highly valued customer, PCS Phosphate, depends on the Port to sell fertilizer products throughout the world – fertilizer that is mined at the PCS mine in Aurora, NC.
   b. Fencing material is delivered from Morehead City to locations throughout North Carolina (such as Salisbury, Henderson, Elizabeth City, and Weldon) and to the East and Gulf Coast regions. Products handled at the Port of Morehead City impact thousands of North Carolinians who earn their living at plants and mills.
   c. The natural rubber from Indonesia is used at the Bridgestone Firestone plant in Wilson and the Goodyear plant in Fayetteville. The Port of Morehead City is the second-largest port in the nation for natural rubber imports.
   d. The scrap steel imported via Morehead City goes to the Nucor mill in Tunis and is used in recycled steel plates.

8. Examples of local economic impacts associated with maritime industry are:
   a. The Authority directly employs 75 people with an annual payroll in excess of $3.5 million.
   b. Related businesses and service providers such as the International Longshoremen's Association, harbor pilots, tug companies, shipping agents, stevedores, surveyors and marine equipment suppliers provide an estimated 250 additional jobs, salaries and revenues to the local economy.
   c. Approximately 1,000 additional induced jobs that include those who work at the stores, restaurants, hospitals, and schools used by port workers.

North Carolina State Ports Authority
113 Arendell Street • Morehead City, NC 28557
• Tel: (252) 808-4205 • Fax: (252) 726-1190 • Email: rex_edwards@ncports.com • http://www.ncports.com

9. The Authority supports and advocates beneficial use of dredge material at each of North Carolina's deepwater ports while ensuring full project dimensions at these ports. We have worked successfully with the NC Division of Water Resources and the U.S. Army Corps of Engineers to place maintenance dredge material on Bogue Banks beaches.

10. The Authority supports efforts to alter the law and policies that require "least cost disposal" by the Corps of Engineers to allow the benefits of beach disposal as positive attributes of a Corps of Engineers' maintenance-dredging project.

11. The beneficial use of a limited resource should be a significant decision making factor in the formulation of a DMMP. Placement of beach quality sand on adjacent public beaches and the resulting regional benefits should be Project accountable. Claiming the benefits from a positive use of a dredged material resource should be used in calculating project justification and the cost benefit ratio. Examples of such benefits are:

    a. Federal and State tax base protection;

    b. Tourism industry protection;

    c. Municipal infrastructure protection;

    d. Potential deferral of FEMA outlays; and,

    e. Environmental restoration.

12. The Authority supports efforts to bolster the Corps of Engineers budget to enable beneficial use of dredge material.

Please feel free to contact me at any time with additional questions or concerns.

Sincerely,

Rex Edwards
Director of Operations, Port of Morehead City

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Raleigh Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726

January 22, 2008

Mr. Stacy Samuelson
Environmental Resources Section
Wilmington District, U. S. Army Corps of Engineers
P. O. Box 1890
Wilmington, North Carolina 28402-1890

Subject: Morehead City Harbor Dredged Material Management Plan

Dear Mr. Samuelson:

This letter provides scoping comments of the U. S. Fish and Wildlife Service (Service) on the proposed Morehead City Harbor Dredged Material Management Plan (DMMP) Project which was briefly outlined in a letter, dated November 26, 2007, from Coleman Long. That letter stated that the Wilmington Corps District (Corps) was initiating work on plans for the long-term (20-years) management of the material dredged from the Morehead City Harbor, Carteret County, North Carolina. The letter also stated that the project would involve data collection, compilation, analyses, evaluations, surveys, mapping, coordination, and management necessary to address the major alternatives and coordinate a DMMP report. Development of the DMMP is expected to be completed in two years.

These comments are submitted in accordance with the Fish and Wildlife Coordination Act (FWCA) (48 Stat. 401, as amended; 16 U.S.C. 661-667d). The FWCA mandates that wildlife conservation shall receive equal consideration and be coordinated with other factors of water-resource development programs through effectual and harmonious planning, development, maintenance, and coordination of wildlife conservation and rehabilitation. The FWCA essentially establishes fish and wildlife conservation as a coequal purpose or objective of federally funded or permitted water resources development projects. Additional comments are provided pursuant to section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531-1543).

The disposition of dredge material from the Morehead City navigation channel over a 20 year period has the potential to impact important fish and wildlife resources in the project area. However, conservation measures are available to minimize the environmental impacts of both the sediment removal and disposition. The Service recommends the following measures be considered in the development of the DMMP:

1. The plan should include a sampling program to determine the physical characteristics of sediment to be removed. These physical characteristics include sand grain size,

density, shear resistance, color, heavy mineral content, calcium carbonate content, and moisture content.

2. The planning process should identify the range of potential disposal locations. Such sites as area beaches, upland disposal areas, and offshore disposal sites should be described and the fish and wildlife resources using each area should be discussed.

3. Based on the physical characteristics of the sediment to be removed, standards should be established for material which would be placed in the various disposal locations. Careful analysis should be used for directing dredge material to oceanfront beaches. Any material to be used as beach fill should have a high degree of compatibility with the native beach. The North Carolina Sediment Criteria Rule, contained in the Technical Standards for Beach Fill Projects (15A NCAC 07H .0312), should be used in regard to grain size and percent weight of calcium carbonate. In addition, compatibility should be established for other important characteristics such as organic content, heavy mineral content, and color. Any beach fill should have a color similar to the natural beach. While sediment compatibility standards may be lower for beach disposal operations than for formal beach construction projects, the Service recommends that all material used for beach fill should have a high degree of compatibility. Any beach disposal resulting from the DMMP should use the same standards of sediment compatibility as those applied to civil works beach construction projects.

4. Sediment removal and disposal should be scheduled during the least sensitive period of the year for the organisms dependent on the habitats to be affected. Dredged material disposal on ocean beaches requires consideration of nesting by federally protected sea turtles as well as the use of these areas by the federally threatened piping plover (*Charadrius melodus*) for nesting, overwintering, and migratory stopovers. Due to the potential harm to these federally protect species, the Service has recommended that dredging and disposal be prohibited during the combined period of sea turtle/piping plover reproductive activities, April 1 through November 15.

5. Project planning should consider the life cycle of beach invertebrates in the scheduling of any beach disposal. Peterson et al. (2000) documented invertebrate populations following disposal of dredge spoil from the Atlantic Intracoastal Waterway in Bogue Sound on the beaches of Bogue Banks during March through May 1990. Populations of important beach invertebrates were reduced by 86-99% (compared to control beaches) five to ten weeks following fill placement. The authors conclude that "failure of *Emerita* [mole crabs] and *Donax* [coquina clams] to recover from nourishment by mid summer when they serve as a primary prey base for important surf fishes, ghost crabs, and some shorebirds may be a consequence of the poor match in grain size and high shell content of source sediments and/or extension of the project too far into the warm season" (Peterson et al. 2000, p. 368, abstract). Scheduling beach disposal outside the larval recruitment period of beach invertebrates will ensure better recovery of these species. Peterson et al. (2000, p. 376) recommend that future sand placements should be designed to end before the onset of the warm season (April or May in North Carolina) when *Donax* and *Emerita* return to the intertidal beach. Therefore, planning for the DMMP should seek to end all

beach disposal operations by March 31 or, at the latest, by April 30 to conserve these invertebrates that form an important food resource for shorebirds and coastal fisheries.

6. Project plans should include measures to avoid adverse impacts associated with placement of the sediment pipeline and measures to monitor and mitigate any spills from the pipeline. Any overland sediment pipeline should be aligned to avoid potential shorebird nesting habitat around inlets and sparsely vegetated, undeveloped sandy flats. Overland pipeline routes should be coordinated with state and federal resource agencies to minimize adverse impacts to shorebirds. In-water pipeline placement should avoid all hardbottom areas, submerged aquatic vegetation (SAV), and areas used by shellfish. There should be a plan to monitor pipelines for leaks and an established plan of action to contain any pipeline spills and to remove sediment resulting from a pipeline spill.

7. The Corps should ensure that no hardbottom habitats are affected by sedimentation produced by the project, either as a result of dredging or sediment washing off the beach.

8. While the use of highly compatible fill material for beach fill would minimize turbidity and sedimentation due to runoff from the disposal area, small inclusions of mud and silt pose a risk to nearshore hardbottoms. Project planning should establish a program to monitor the location, areal extent, and major organisms of nearshore hardbottoms prior to implementation of the DMMP. These areas should be surveyed after each beach disposal operation to determine if any adverse sedimentation or changes in the biological community occurred. If it is determined that nearshore hardbottoms are being covered by sediment moving off beach disposal areas, the monitoring program should determine the overall loss of exposed hardbottoms. The DMMP should include a protocol for developing and implementing appropriate mitigation measures for any loss of nearshore hardbottoms. Mitigation measures could include a reduction in the amount of beach fill near vulnerable hardbottoms.

9. Project plans should include measures to ensure that no SAV is adversely affected by either dredging or disposal activities. These measures should include mapping of existing SAV areas prior to implementation of the DMMP and periodic assessment of SAV areas throughout the 20 years of the plan. If dredging or sediment disposal (e.g., runoff of muddy water from a confined disposal facility) results in the loss of SAV, the Corps should coordinate with state and federal resource agencies to develop a mitigation strategy.

10. All beach disposal operations should include surveys for seabeach amaranth (*Amaranthus pumilus*) both before placement and for three years after disposal to avoid direct burial and to monitor recovery of the plant. If data indicate a declining trend in the presence of this federally threatened species, the development of mitigation measures should be part of the DMMP. If beach vitex (*Vitex rotundifolia*), a harmful invasive foreign plant, occurs on any of the beaches to be maintained by disposal operations, the Corps should considering establishing a program to monitor the species and develop efforts to eradicate the plant.

11. Piping plovers are especially susceptible to human disturbance during territory establishment, early nesting attempts, and after the chicks have hatched. Therefore, the work on each beach disposal event should start in less developed areas, such as near an inlet, and progress toward more developed areas over the winter months. For example, a disposal operation starting in December on the eastern end of Bogue Banks should start near the inlet at Fort Macon State Park and move westward toward Atlantic Beach. This order of disposal would result in sediment disposal during late winter and early spring in the more developed parts of the island which are less likely to be used for shorebird nesting.

12. Nesting by sea turtles will benefit from high sediment compatibility standards and work schedules that avoid the nesting season. All beach disposals should occur outside the recognized nesting and incubation season of May 1 through November 15. However, artificial beaches pose additional risks to sea turtle nesting due to: (1) sediment compaction; (2) escarpment formation; and, (3) altered sand temperature which may occur as a result of a change in sediment color. To mitigate sediment compaction, the Service recommends that compaction monitoring should occur after each construction event and for three subsequent years. However, compaction monitoring would not be required if the sediment used to construct the beach is completely washed away. Beach tilling to correct beach compaction should only be performed as a result of an identified compaction problem and not performed routinely in place of compaction monitoring. Similarly, visual surveys for escarpments should be made along the constructed beach immediately after completion of the sediment placement and prior to May 1. Additional surveys should be made for three years following initial construction. Survey results should be submitted to the Service prior to any action being taken. After discussion with the Service, escarpments that interfere with sea turtle nesting or exceed 18 inches in height for a distance of 100 feet should be leveled to the natural beach contour by May 1. The Service should be contacted immediately if new escarpments that interfere with sea turtle nesting or exceed 18 inches in height for a distance of 100 feet form during the nesting and hatching season to determine the appropriate action to be taken. If it is determined that escarpment leveling is required during the nesting or hatching season, the Service will provide a brief written authorization that describes methods to be used to reduce the likelihood of impacting existing nests.

13. During any beach disposal operation, the DMMP should include a program for detecting and securing appropriate care for stranded sea turtles. In many beach communities, private conservation groups consisting of state-approved volunteers already provide a means for recovering stranded sea turtles and a protocol for ensuring that care is made available for those turtles that can be retuned to the ocean.

13. While the West Indian manatee is not likely to be in the project area during a work period from mid-November through April 30, protective measures should be in place to safeguard this endangered species. Corps plans call for the implementation of the Service's "Precautions for General Construction in Areas Which May Be Used by the West Indian Manatee in North Carolina." These guidelines should provide adequate protection for this species.

14. With regard to all federally protected species, the Corps should prepare a Biological Assessment (BA) in accordance with section 7 of the ESA. The BA should describe the potential impacts of the DMMP on each listed species which is likely to occur in the project area. The BA should discuss the conservation measures for the species that will be part of the plan and provide a determination of the extent to which each species will be affected over the entire course of the project.

15. While routine maintenance dredging can be planned based on historic rates of sediment accumulation, emergency situations may arise as a result of hurricanes or other unpredictable events. In emergency situations which threaten navigation, dredge spoil will be generated and the DMMP should address the disposal of this material. The DMMP should define the conditions that would require emergency dredging. The DMMP should clearly state whether emergency dredging will be initiated solely for navigation purposes or as a result of excessive shoreline recession which threatens structures near the beach. That is, the plan should state whether emergency dredging could be initiated solely on the basis of a need for beach fill when there was no threat to navigation.

A thorough consideration of these issues in the development of the Morehead City Harbor DMMP would reduce the adverse environmental impacts that could arise during the 20 years of the plan. The Service appreciates the opportunity to provide these comments and we look forward to continued involvement with the Corps on this project. Please keep this office informed on progress in the planning process. The Service would like to be informed of any scoping meetings for the plan. Any questions regarding these comments should be directed to Howard Hall at 919-856-4520, ext 27, or by e-mail at < howard_hall@fws.gov >.

Sincerely,

John S. Hammond
for Pete Benjamin
Field Supervisor

Literature cited

Peterson, C. H., D. H. M. Hickerson, and G. G. Johnson. 2000. Short-term consequences of nourishment and bulldozing on the dominant large invertebrates of a sandy beach. Journal of Coastal Research. 16:368-378.

cc:

Ron Sechler, National Marine Fisheries Service, Beaufort, NC

Fritz Rohde, NC Division of Marine Fisheries, Wilmington, NC
Stephen Rynas, NC Division of Coastal Management, Morehead City, NC
Maria Dunn, NC Wildlife Resources Commission, Washington, NC
Susan Cameron, NC Wildlife Resources Commission, Stella, NC
Matthew Godfrey, Wildlife Resources Commission, Beaufort, NC

North Carolina
Department of Administration

Michael F. Easley, Governor | Britt Cobb, Secretary

January 17, 2008

U.S. Army - Corps of Engineers
Wilmington District
Attention: Mr. Stacy Samuelson (CESAW-TS-PE)
P.O. Box 1890
Wilmington, NC 28402-1890

Dear Mr.Samuelson:

Re: SCH File # 08-E-0000-0157; Scoping; Development of the Morehead City Harbor Dredging Material Management Plan (DMMP) to address long-term (20-year) management of the dredged material from Morehead City Harbor in Carteret County.

The above referenced environmental impact information has been submitted to the State Clearinghouse under the provisions of the National Environmental Policy Act. According to G.S. 113A-10, when a state agency is required to prepare an environmental document under the provisions of federal law, the environmental document meets the provisions of the State Environmental Policy Act. Attached to this letter for your consideration are the comments made by agencies in the course of this review.

If any further environmental review documents are prepared for this project, they should be forwarded to this office for intergovernmental review.

Should you have any questions, please do not hesitate to call.

Sincerely,
Chrys Baggett/STG

Ms. Chrys Baggett
Environmental Policy Act Coordinator

Attachments

cc: Region P
Mr. W. Coleman Long, U.S. Army Corps of Engineers

Mailing Address:
1301 Mail Service Center
Raleigh, NC 27699-1301

Telephone: (919)807-2425
Fax (919)733-9571
State Courier #51-01-00
e-mail Chrys.Baggett@ncmail.net

Location Address:
116 West Jones Street
Raleigh, North Carolina

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NCDENR

North Carolina Department of Environment and Natural Resources

Michael F. Easley, Governor

William G. Ross Jr., Secretary

JAN 2008
RECEIVED
Secretary's Office
DOA

MEMORANDUM

TO: Chrys Baggett
State Clearinghouse

FROM: Melba McGee
Project Review Coordinator

RE: 08-0157 Scoping, Morehead City Harbor Dredged Material Management Plan, Carteret County

DATE: January 15, 2008

The Department of Environment and Natural Resources has reviewed the proposed project. The attached comments are a result of this review. More specific comments will be provided during the environmental review process.

Thank you for the opportunity to respond. If during the preparation of the environmental document, additional information is needed, the applicant is encouraged to notify our respective divisions.

Attachment

1601 Mail Service Center, Raleigh, North Carolina 27699-1601
Phone: 919-733-4984 \ FAX: 919-715-3060 \ Internet: www.enr.state.nc.us/ENR/

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NCDENR
North Carolina Department of Environment and Natural Resources
Division of Marine Fisheries
Michael F. Easley, Governor
William G. Ross Jr., Secretary
Dr. Louis B. Daniel III, Director

December 20, 2007

US Army Corps of Engineers
Wilmington District
Attention: Mr. Stacy Samuelson (CESAW-TS-PE)
PO Box 1890
Wilmington, NC 28402-1890

Dear Mr. Samuelson:

The North Carolina Division of Marine Fisheries (DMF) would like to offer the following comments concerning development of the Morehead City Harbor Dredged Material Management Plan (DMMP).

The North Carolina Coastal Habitat Protection Plan (CHPP) which was developed through the efforts of staff from DMF, NC Division of Coastal Management, NC Division of Water Quality, NC Wildlife Resources Commission, and NC Division of Environmental Health and adopted by the NC Marine Fisheries Commission, NC Environmental Management Commission and NC Coastal Resources Commission makes the following recommendations concerning studies necessary for the proper use of dredge material for beach renourishment:

1. Identify more specific minimum and maximum sediment grain sizes to minimize biological impacts to the intertidal beach community.

2. Determine the minimum distance required between undisturbed areas within/bordering the renourishment project to provide adequate sources of intertidal organism for recolonization and food for fish.

3. Determine the time interval between projects to allow full recovery of benthic communities based on project season/duration, compatibility of sediment size and other parameters.

The CHPP also contains the following recommendations concerning beach renourishment projects:

1. Restrict beach nourishment projects to winter months to minimize mortality of infauna and enhance recovery rates of intertidal benthic organisms.

2. Conduct adequate monitoring of the effects of beach nourishment on the soft bottom community and associated surf fish populations.

The NC Marine Fisheries Commission has also established the following general policies related to large-scale beach dredge-and-fill projects:

1. Projects should fulfill the Commission's general habitat policy by avoiding, minimizing and offsetting damage to the marine and estuarine resources of North Carolina;

2. Projects should provide detailed analyses of possible impacts to each type of essential Fish habitat (EFH), with careful detailed analyses of possible impacts to Habitat Areas of Particular Concern (HAPC) and Critical Habitat Areas (CHA), including short and long term, and population and ecosystem scale effects;

3. Projects should provide a full range of alternatives, along with assessments of the relative impacts of each on each type of EFH, HAPC, and CHA;

4. Projects should avoid impacts on EFH, HAPCs and CHAs that are shown to be avoidable through the alternative analysis, and minimize impacts that are not;

5. Projects should include assessments of potential unavoidable damage to marine resources, using conservative assumptions;

6. Projects should be conditioned on the avoidance of avoidable impacts, and should include compensatory mitigation for all reasonably predictable impacts to the marine and estuarine resources of North Carolina, taking into account uncertainty about these effects. Mitigation should be local, up-front and in-kind wherever possible;

7. Projects should include baseline and project-related monitoring adequate to document pre-project conditions and impacts of the projects on the marine and estuarine resources of North Carolina;

8. All assessments should be based upon the best available science, and be appropriately conservative so as to be prudent and precautionary; and

9. All assessments should take into account the cumulative impacts associated with other beach dredge and-fill projects in North Carolina and adjacent states, and other large--scale coastal engineering projects that are ecologically related.

Thank you for the opportunity to comment on development of the DMMP. Please inform DMF of the date and location of the scoping meeting.

Sincerely,

Michael D. Marshall

Michael D. Marshall
Central District Manager

NCDENR
North Carolina Department of Environment and Natural Resources
Division of Coastal Management
Michael F. Easley, Governor | **James H. Gregson, Director** | William G. Ross Jr., Secretary

January 8, 2008

Melba McGee
Environmental Coordinator
Office of Legislative & Intergovernmental Affairs
Department of Environment and Natural Resources
1601 Main Service Center
Raleigh, NC 27699-0001

SUBJECT: Proposed Morehead City Harbor Dredged Material Management Plan, Carteret County, North Carolina (SCH#08-0157, and DCM#20070122)

Dear Ms. McGee:

Thank you for the opportunity to review the letter from the US Army Corps of Engineers (Corps) requesting comments on the environmental issues that should be incorporated into the proposed Morehead City Harbor Dredged Material Management Plan (DMMP). The DMMP proposes to address long-term (20-year) management of the dredged material from Morehead City Harbor. The DMMP studies will involve a variety of activities such as: data collection, analysis, evaluations, mapping, coordination, and management actions necessary to implement the DMMP. Below are the comments by the Division of Coastal Management (DCM).

- The DMMP (proposed project) will require consistency review and concurrence by DCM before the DMMP can be implemented. Since this proposed management plan involves dredging, the State's Dredge and Fill Law, a component of the State's coastal management program, also constitutes some of the relevant enforceable policies. DCM recommends that the DMMP comply with the information requirements of 15 CFR 930.39.
- In developing the DMMP, DCM recommends that 15A NCAC 07H .0312 be consulted regarding the technical standards for beach fill projects. Additionally 15A NCAC 07H .0308(a)(3) requires that sand used for beach nourishment be compatible with existing grain size and type of the receiving beach.
- DCM recommends that the DMMP incorporate the requirements of Section (h2) of the State's Dredge and Fill Law which requires that clean beach quality material dredged from navigational channels or inlet shoal systems be deposited onto ocean beaches.
- DCM recommends that the DMMP incorporate the standard that sand used for beach nourishment shall be taken only from those areas where the resulting environmental impacts will be minimal.
- DCM recommends that the capability of Brandt Island (or any other dredge disposal island) to accept dredged material over the operational life of the DMMP be evaluated.

- DCM recommends the DMMP review all moratorium periods and equipment operating limitations. For example, side cast dredging is not recommend in areas where SAV beds occur. DCM encourages the DMMP to specify the types of dredging equipment that may be used and to identify periods when dredging operations may not be conducted due to environmental constraints.
- DCM recommends that the disposal of dredged material in offshore locations be segregated by whether the material is beach quality or not beach quality. Segregating the material in this manner could allow for more rapid retrieval of beach quality sand should it be needed.
- DCM and the North Carolina Division of Water Resources (NCDWR) are working on a Comprehensive Beach And Inlet Management Plan (BIMP). DCM recommends that the Corps, in developing the DMMP, collaborate with this effort and incorporate Regional Sediment Management Plan (RSM) findings. It is our understanding that the Corps is authorized under the Water Resources and Development Act (WRDA) passed by Congress in November 2007 to participate in the RSM.
- DCM recommends that the Corps collaborate with DCM, NCDWR, and other relevant State agencies to integrate the DMMP with the State's BIMP.
- It is our understanding the Corps' Wilmington District is working with the Corps' Mobile District in developing an "eCoastal Enterprise GIS Framework". DCM recommends that the feasibility of incorporating the eCoastal Enterprise GIS Framework system to the DMMP be explored.
- Carteret County has developed an online database containing all of their relevant data related to beach nourishment and storm protection (shorelines, aerial photos, monitoring surveys, volume calculations, etc.). DCM recommends that the Corps contact Carteret County to investigate how this information can be incorporated into the DMMP.
- The DMMP consistency review, potentially involves two types of consistency reviews by DCM. The first type of concurrence would be with the management plan itself. The second type of concurrence would involve review of actual dredging and disposal operations. To minimize the number of concurrence reviews, the Corps may make a combined consistency submission. A combined consistency submission would require explicit plans for proposed dredging and disposal operations.
- DCM recognizes that certain dredging operations are conducted for a variety of purposes. As such, the disposal of disposal of beach quality material onto the beach may or may not be within the scope of a proposed dredging operation. Nevertheless, the State's coastal management program encourages the placement of beach quality material onto the beach. To the extent practicable[1] DCM encourages that the Corps comply[2] with the State's coastal management program mandate to place beach quality sand onto the beach.
- To assure the efficient management of dredged material from dredging to disposal, DCM suggests that the DMMP be integrated with "*real-time*" dredging operations. To express this differently, DCM recommends that the DMMP not simply focus on the management of

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1 The term "*consistent to the maximum extent practicable*" is defined in 15 CFR 930.32 and means "*fully consistent with the enforceable policies of management programs unless full consistency is prohibited by existing law applicable to the Federal agency.*"

2 In discussing funding issues and compliance with a State's coastal management program 15 CFR 930.32 states "***Federal agencies shall not use a general claim of a lack of funding** or insufficient appropriated funds or failure to include the cost of being fully consistent in Federal budget and planning process **as a basis for being consistent to the maximum extent practicable with an enforceable policy of a management program**. The only circumstance where a Federal agency may rely on a lack of funding as a limitation on being fully consistent with an enforceable policy is the Presidential exemption described in section 307(c)(1)(B) of the Act (16 USC 1456(c)(1)(B). In Cases where the cost of being consistent with the enforceable policies of a management program was not included in the Federal agency's budget and planning processes, **the Federal agency should determine the amount of funds needed and seek additional federal funds.***" (emphasis added)

material following its storage at dredge disposal locations such as Brandt Island. Instead DCM recommends that the DMMP focus on how material that is dredged can be immediately moved to a disposal location, such as a beach, to minimize the necessity for intermediate storage. DCM acknowledges that in certain situations intermediate storage may provide future benefits such as the immediate availability of beach quality sand for emergency beach disposal resulting from an unexpected erosion event.

- Emergency dredging operations have been an ongoing concern. DCM acknowledges that the ocean environment is complex and unpredictable, and that storm events can trigger the unexpected need for emergency dredging. Nevertheless, many proposals for emergency dredging have been the result of operational issues such as unavailability of equipment, equipment breakdowns, and funding constraints. DCM suggests that the DMMP incorporate separate operational protocols for dealing with emergency dredging resulting from storm events and protocols concerning operational (equipment) issues that affect planned dredging operations.

Should you wish to discuss any of these recommendations further, please feel free to contact me at 252-808-2808. Thank you for your consideration of the North Carolina Coastal Management Program.

Sincerely,

Stephen Rynas, AICP
Federal Consistency Coordinator

cc: Jim Gregson, Division of Coastal Management
Doug Huggett, Division of Coastal Management
Terc Barrett, Division of Coastal Management
Jeff Warren, Division of Coastal Management

MEMORANDUM

DIVISION OF WATER QUALITY

TO: Melba McGee, Environmental Coordinator

FROM: Joanne Steenhuis, Senior Environmental Specialist JHS 12/5/07

THROUGH: Edward Beck, Surface Water Protection Regional Supervisor EB

DATE: December 5, 2007

SUBJECT: Morehead City Harbor Dredged Material Management Plan (DMMP)

PROJECT: Morehead City Harbor Dredged Material Management Plan (DMMP)
20-year management plan
Project No. 08-0157

COUNTY: Carteret County

The Wilmington Regional Office has reviewed the initiation letter for the scoping process for the Morehead City Harbor 20 year dredged material management plan. This Office is concerned with any potential contaminants that may be stirred into the water column during this process and the location or placement of the material for disposal (potential wetland fill).

Thank You

State of North Carolina
Department of Environment and Natural Resources

Reviewing Office: Wiro

INTERGOVERNMENTAL REVIEW - PROJECT COMMENTS

Project Number: 08-0157 Due Date: 1/9/08

After review of this project it has been determined that the ENR permit(s) and/or approvals indicated may need to be obtained in order for this project to comply with North Carolina Law. Questions regarding these permits should be addressed to the Regional Office indicated on the reverse of the form. All applications, information and guidelines relative to these plans and permits are available from the same Regional Office.

	PERMITS	SPECIAL APPLICATION PROCEDURES or REQUIREMENTS	Normal Process Time (statutory time limit)
☐	Permit to construct & operate wastewater treatment facilities, sewer system extensions & sewer systems not discharging into state surface waters.	Application 90 days before begin construction or award of construction contracts. On-site inspection. Post-application technical conference usual.	30 days (90 days)
☐	NPDES - permit to discharge into surface water and/or permit to operate and construct wastewater facilities discharging into state surface waters.	Application 180 days before begin activity. On-site inspection. Pre-application conference usual. Additionally, obtain permit to construct wastewater treatment facility-granted after NPDES. Reply time, 30 days after receipt of plans or issue of NPDES permit-whichever is later.	90-120 days (N/A)
☐	Water Use Permit	Pre-application technical conference usually necessary	30 days (N/A)
☐	Well Construction Permit	Complete application must be received and permit issued prior to the installation of a well.	7 days (15 days)
☐	Dredge and Fill Permit	Application copy must be served on each adjacent riparian property owner. On-site inspection. Pre-application conference usual. Filling may require Easement to Fill from N.C. Department of Administration and Federal Dredge and Fill Permit.	55 days (90 days)
☐	Permit to construct & operate Air Pollution Abatement facilities and/or Emission Sources as per 15 A NCAC (2Q.0100 thru 2Q.0300)	Application must be submitted and permit received prior to construction and operation of the source. If a permit is required in an area without local zoning, then there are additional requirements and timelines (2Q.0113).	90 days
☐	Permit to construct & operate Transportation Facility as per 15 A NCAC (2D.0800, 2Q.0601)	Application must be submitted at least 90 days prior to construction or modification of the source.	90 days
☐	Any open burning associated with subject proposal must be in compliance with 15 A NCAC 2D.1900	N/A	60 days (90 days)
☐	Demolition or renovations of structures containing asbestos material must be in compliance with 15 A NCAC 20.1110 (a) (1) which requires notification and removal prior to demolition. Contact Asbestos Control Group 919-707-5950.		
☐	Complex Source Permit required under 15 A NCAC 2D.0800		
☐	The Sedimentation Pollution Control Act of 1973 must be properly addressed for any land disturbing activity. An erosion & sedimentation control plan will be required if one or more acres to be disturbed. Plan filed with proper Regional Office (Land Quality Section) At least 30 days before beginning activity. A fee of **$65** for the first acre or any part of an acre. An express review option is available with additional fees.		20 days (30 days)
☐	Sedimentation and erosion control must be addressed in accordance with NCDOT's approved program. Particular attention should be given to design and installation of appropriate perimeter sediment trapping devices as well as stable stormwater conveyances and outlets.		(30 days)
☐	Mining Permit	On-site inspection usual. Surety bond filed with ENR Bond amount varies with type mine and number of acres of affected land. Any arc mined greater than one acre must be permitted. The appropriate bond must be received before the permit can be issued.	30 days (60 days)
☐	North Carolina Burning permit	On-site inspection by N.C. Division Forest Resources if permit exceeds 4 days	1 day (N/A)
☐	Special Ground Clearance Burning Permit - 22 counties in coastal N.C. with organic soils	On-site inspection by N.C. Division Forest Resources required "if more than five acres of ground clearing activities are involved. Inspections should be requested at least ten days before actual burn is planned."	1 day (N/A)
☐	Oil Refining Facilities	N/A	90-120 days (N/A)
☐	Dam Safety Permit	If permit required, application 60 days before begin construction. Applicant must hire N.C. qualified engineer to: prepare plans, inspect construction. certify construction is according to ENR approved plans. May also require permit under mosquito control program. And a 404 permit from Corps of Engineers. An inspection of site is necessary to verify Hazard Classification. A	30 days (60 days)

	PERMITS	SPECIAL APPLICATION PROCEDURES or REQUIREMENTS	Normal Process Time (statutory time limit)
☐	Permit to drill exploratory oil or gas well	File surety bond of $5,000 with ENR running to State of NC conditional that any well opened by drill operator shall, upon abandonment, be plugged according to ENR rules and regulations.	10 days N/A
☐	Geophysical Exploration Permit	Application filed with ENR at least 10 days prior to issue of permit. Application by letter. No standard application form.	10 days N/A
☐	State Lakes Construction Permit	Application fees based on structure size is charged. Must include descriptions & drawings of structure & proof of ownership of riparian property.	15-20 days N/A
☒	401 Water Quality Certification	N/A	60 days (130 days)
☐	CAMA Permit for MAJOR development	$250.00 fee must accompany application	55 days (150 days)
☐	CAMA Permit for MINOR development	$50.00 fee must accompany application	22 days (25 days)
☐	Several geodetic monuments are located in or near the project area. If any monument needs to be moved or destroyed, please notify: N.C. Geodetic Survey, Box 27687 Raleigh, NC 27611		
☐	Abandonment of any wells, if required must be in accordance with Title 15A. Subchapter 2C.0100.		
☐	Notification of the proper regional office is requested if "orphan" underground storage tanks (USTS) are discovered during any excavation operation.		
☐	Compliance with 15A NCAC 2H 1000 (Coastal Stormwater Rules) is required.		45 days (N/A)
☐	Tar Pamlico or Neuse Riparian Buffer Rules required.		
★	Other comments (attach additional pages as necessary, being certain to cite comment authority)		

REGIONAL OFFICES

Questions regarding these permits should be addressed to the Regional Office marked below.

☐ **Asheville Regional Office**
2090 US Highway 70
Swannanoa, NC 28778
(828) 296-4500

☐ **Mooresville Regional Office**
610 East Center Avenue, Suite 301
Mooresville, NC 28115
(704) 663-1699

☒ **Wilmington Regional Office**
127 Cardinal Drive Extension
Wilmington, NC 28405
(910) 796-7215

☐ **Fayetteville Regional Office**
225 North Green Street, Suite 714
Fayetteville, NC 28301-5043
(910) 433-3300

☐ **Raleigh Regional Office**
3800 Barrett Drive, Suite 101
Raleigh, NC 27609
(919) 791-4200

☐ **Winston-Salem Regional Office**
585 Waughtown Street
Winston-Salem, NC 27107
(336) 771-5000

☐ **Washington Regional Office**
943 Washington Square Mall
Washington, NC 27889

Water Quality Certification No. 3888

GENERAL CERTIFICATION FOR PROJECTS ELIGIBLE
FOR U.S. ARMY CORPS OF ENGINEERS NATIONWIDE PERMIT NUMBER 16
(RETURN WATER FROM UPLAND CONTAINED DISPOSAL AREAS)
AND RIPARIAN AREA PROTECTION RULES (BUFFER RULES)

Water Quality Certification Number 3888 is issued in conformity with the requirements of Section 401, Public Laws 92-500 and 95-217 of the United States and subject to the North Carolina Division of Water Quality Regulations in 15A NCAC 02H .0500 and 15A NCAC 02B .0200 for the discharge of fill material to waters and wetlands as described in 33 CFR 330 Appendix A (B) (16) and the Riparian Area Protection Rules (Buffer Rules) in 15A NCAC 02B .0200.

The category of activities shall include the discharge of return water from an upland, contained dredge disposal area.

The State of North Carolina certifies that the specified category of activity will not violate applicable portions of Sections 301, 302, 303, 306 and 307 of the Public Laws 92-500 and 95-217 if conducted in accordance with the conditions hereinafter set forth.

Activities meeting any one (1) of the following thresholds or circumstances require *written approval* for a 401 Water Quality Certification from the Division of Water Quality (the "Division"):

a) Proposed fill or modification of wetlands or waters, including streams; or
b) Any stream relocation; or
c) Any impact associated with a Notice of Violation or an enforcement action for violation(s) of DWQ Wetland Rules (15A NCAC 02H .0500), Isolated Wetland Rules (15A NCAC 02H .1300), DWQ Surface Water or Wetland Standards, or Riparian Buffer Rules (15A NCAC 02B .0200); or
d) Any impacts to streams and/or buffers in the Neuse, Tar-Pamlico, or Catawba River Basins or in the Randleman, Jordan or Goose Creek Watersheds (or any other basin or watershed with Riparian Area Protection Rules [Buffer Rules] in effect at the time of application) *unless* the activities are listed as "EXEMPT" from these rules or a Buffer Authorization Certificate is issued through N.C. Division of Coastal Management (DCM) delegation for "ALLOWABLE" activities.

In accordance with North Carolina General Statute 143-215.3D(e), written approval for a 401 Water Quality General Certification must include the appropriate fee. If a project also requires a CAMA Permit, then one payment to both agencies shall be submitted and will be the higher of the two fees.

Activities included in this General Certification that do not meet one of the thresholds listed above do not require written approval from the Division as long as they comply with the Conditions of Certification listed below. If any of these Conditions cannot be met, then written approval from the Division is required.

Conditions of Certification:

1. No Impacts Beyond those Authorized in the Written Approval or Beyond the Threshold of Use of this Certification

   No waste, spoil, solids, or fill of any kind shall occur in wetlands, waters, or riparian areas beyond the footprint of the impacts depicted in the Pre-Construction Notification, as authorized in the written approval from the Division or beyond the thresholds established for use of this Certification without written authorization, including incidental impacts. All construction activities, including the design, installation, operation, and maintenance of sediment and erosion control Best Management Practices shall be performed so that no violations of state water quality standards, statutes, or rules occur. Approved plans and specifications for this project are incorporated by reference and are enforceable parts of this permit.

2. Standard Erosion and Sediment Control Practices

Erosion and sediment control practices must be in full compliance with all specifications governing the proper design, installation and operation and maintenance of such Best Management Practices and if applicable, comply with the specific conditions and requirements of the NPDES Construction Stormwater Permit issued to the site:

a. Design, installation, operation, and maintenance of the sediment and erosion control measures must be such that they equal or exceed the requirements specified in the most recent version of the *North Carolina Sediment and Erosion Control Manual*. The devices shall be maintained on all construction sites, borrow sites, and waste pile (spoil) projects, including contractor-owned or leased borrow pits associated with the project.

b. For borrow pit sites, the erosion and sediment control measures must be designed, installed, operated, and maintained in accordance with the most recent version of the *North Carolina Surface Mining Manual*.

c. Reclamation measures and implementation must comply with the reclamation in accordance with the requirements of the Sedimentation Pollution Control Act and the Mining Act of 1971.

d. Sufficient materials required for stabilization and/or repair of erosion control measures and stormwater routing and treatment shall be on site at all times.

e. If the project occurs in waters or watersheds classified as Primary Nursery Areas (PNAs), SA, WS-I, WS-II, High Quality (HQW), or Outstanding Resource (ORW) waters, then the sedimentation and erosion control designs must comply with the requirements set forth in 15A NCAC 04B .0124, *Design Standards in Sensitive Watersheds*.

3. No Sediment and Erosion Control Measures in Wetlands or Waters

Sediment and erosion control measures shall not be placed in wetlands or waters. Exceptions to this condition require application submittal to and written approval by the Division. If placement of sediment and erosion control devices in wetlands and waters is unavoidable, then design and placement of temporary erosion control measures shall not be conducted in a manner that may result in dis-equilibrium of wetlands, stream beds, or banks, adjacent to or upstream and downstream of the above structures. All sediment and erosion control devices shall be removed and the natural grade restored within two (2) months of the date that the Division of Land Resources (DLR) or locally delegated program has released the specific area within the project.

4. Construction Stormwater Permit NCG010000

An NPDES Construction Stormwater Permit is required for construction projects that disturb one (1) or more acres of land. This Permit allows stormwater to be discharged during land disturbing construction activities as stipulated in the conditions of the permit. If your project is covered by this permit, full compliance with permit conditions including the erosion & sedimentation control plan, inspections and maintenance, self-monitoring, record keeping and reporting requirements is required. A copy of the general permit (NCG010000), inspection log sheets, and other information may be found at http://portal.ncdenr.org/web/wq/ws/su/npdessw#tab-w .

The North Carolina Department of Transportation (NCDOT) shall be required to be in full compliance with the conditions related to construction activities within the most recent version of their individual NPDES (NCS000250) stormwater permit.

5. Construction Moratoriums and Coordination

The timing of the dredging and discharge shall be addressed by the applicant in the Pre-construction Notification Application, in order to lessen impact on aquatic organisms and their reproduction. This timing shall comply with dredging windows established by the NC Wildlife Resources Commission, NC Division of Marine Fisheries, and/or the US Fish and Wildlife Service.

If activities must occur during periods of high biological activity (i.e. sea turtle nesting, fish spawning, or bird nesting), then biological monitoring may be required at the request of other state or federal agencies and coordinated with these activities.

All moratoriums on construction activities established by the NC Wildlife Resources Commission (WRC), US Fish and Wildlife Service (USFWS), NC Division of Marine Fisheries (DMF), or National Marine Fisheries Service (NMFS) to lessen impacts on trout, anadromous fish, larval/post-larval fishes and crustaceans, or other aquatic species of concern shall be implemented. Exceptions to this condition require written approval by the resource agency responsible for the given moratorium.

Work within the twenty-five (25) designated trout counties or identified state or federal endangered or threatened species habitat shall be coordinated with the appropriate WRC, USFWS, NMFS, and/or DMF personnel.

6. Work in the Dry

All work in or adjacent to stream waters shall be conducted so that the flowing stream does not come in contact with the disturbed area. Approved best management practices from the most current version of the NC Sediment and Erosion Control Manual, or the NC DOT Construction and Maintenance Activities Manual, such as sandbags, rock berms, cofferdams, and other diversion structures shall be used to minimize excavation in flowing water. Exceptions to this condition require application submittal to and written approval by the Division.

7. Riparian Area Protection (Buffer) Rules

Activities located in the protected riparian areas (whether jurisdictional wetlands or not), within the Neuse, Tar-Pamlico, or Catawba River Basins or in the Randleman, Jordan, or Goose Creek Watersheds (or any other basin or watershed with buffer rules) shall be limited to "uses" identified within and constructed in accordance with 15A NCAC 02B .0233, .0259, .0243, .0250, .0267 and .0605, and shall be located, designed, constructed, and maintained to have minimal disturbance to protect water quality to the maximum extent practicable through the use of best management practices. All buffer rule requirements, including diffuse flow requirements, must be met.

8. If concrete is used during the construction, then all necessary measures shall be taken to prevent direct contact between uncured or curing concrete and waters of the state. Water that inadvertently contacts uncured concrete shall not be discharged to waters of the state due to the potential for elevated pH and possible aquatic life/ fish kills.

9. The discharge shall not contain levels of toxic pollutants that would result in a violation of state water quality and wetland standards.

10. The terminal end of the pipeline from the dredge into the retention area shall be positioned at a maximum distance from spillways to allow adequate settling of suspended solids and a sufficient distance from any part of the dike so as to preclude dike erosion by the pipeline discharge. Effluent shall be released waterward of emergent marsh or tidal flats when located within these systems.

11. A water control structure shall be installed at the intake end of the effluent leading from the retention area in order to insure maximum settling of suspended solids and control of discharge volumes.

12. The flow from the diked retention area shall be contained by pipe, metal or wooden trough, or similar device to a point waterward of any emergent vegetation along the shoreline unless it can be clearly shown by the applicant that a different design will result in less environmental impact.

13. Sufficient freeboard shall be maintained within the diked disposal area during the dredging operation to assure the integrity of the dike structure and the containment of the dredged material.

14. Native forested vegetation shall be re-established in any construction access or other temporary impact area within the next growing season following construction of a project.

15. Hydraulic dredging in piedmont and mountain lakes (as well as some locations in the coastal plain when specified by the Division) which utilize an upland diked disposal basin with a return pipe for the return water shall utilize the "two basin" design, or have written approval from the Division to vary from this design.

16. The concentration of settleable solids in the effluent being discharged from the diked disposal area shall be no greater than 0.1 ml/l.

17. The appropriate turbidity water quality standard shall not be exceeded or be above ambient background levels (whichever is more stringent) beyond an appropriate mixing zone if one is established for a project by the Division.

18. The disposal area dikes shall be stabilized with vegetative cover within one (1) day after construction to minimize erosion.

19. If an environmental document is required under the National or State Environmental Policy Act (NEPA or SEPA), then this General Certification is not valid until a Finding of No Significant Impact (FONSI) or Record of Decision (ROD) is issued by the State Clearinghouse.

20. In the twenty (20) coastal counties, the appropriate DWQ Regional Office must be contacted to determine if Coastal Stormwater Regulations will be required.

21. This General Certification does not relieve the applicant of the responsibility to obtain all other required Federal, State, or Local approvals.

22. The applicant/permittee and their authorized agents shall conduct all activities in a manner consistent with State water quality standards (including any requirements resulting from compliance with §303(d) of the Clean Water Act), and any other appropriate requirements of State and Federal Law. If the Division determines that such standards or laws are not being met, including failure to sustain a designated or achieved use, or that State or Federal law is being violated, or that further conditions are necessary to assure compliance, then the Division may reevaluate and modify this General Water Quality Certification.

23. When written authorization is required for use of this certification, upon completion of all permitted impacts included within the approval and any subsequent modifications, the applicant shall be required to return the certificate of completion attached to the approval. One copy of the certificate shall be sent to the DWQ Central Office in Raleigh at 1650 Mail Service Center, Raleigh, NC, 27699-1650.

24. Additional site-specific conditions, including monitoring and/or modeling requirements, may be added to the written approval letter for projects proposed under this Water Quality Certification in order to ensure compliance with all applicable water quality and effluent standards.

25. This certification grants permission to the director, an authorized representative of the Director, or DENR staff, upon the presentation of proper credentials, to enter the property during normal business hours.

This General Certification shall expire on the same day as the expiration date of the corresponding Nationwide and/or Regional General Permit. The conditions in effect on the date of issuance of Certification for a specific project shall remain in effect for the life of the project, regardless of the expiration date of this Certification.

Non-compliance with or violation of the conditions herein set forth by a specific project may result in revocation of this General Certification for the project and may also result in criminal and/or civil penalties.

The Director of the North Carolina Division of Water Quality may require submission of a formal application for Individual Certification for any project in this category of activity if it is determined that the project is likely to have a significant adverse effect upon water quality, including state or federally listed endangered or threatened aquatic species, or degrade the waters so that existing uses of the wetland or downstream waters are precluded.

Public hearings may be held for specific applications or group of applications prior to a Certification decision if deemed in the public's best interest by the Director of the North Carolina Division of Water Quality.

Effective date March 19, 2012

DIVISION OF WATER QUALITY

By

Mason Matson for

Charles Wakild, P.E.

Director

History Note: Water Quality Certification (WQC) Number 3888 issued March 19, 2012, replaces WQC 3700 issued November 1, 2007; WQC Number 3629 issued March 19, 2007; WQC Number 3363 issued March 18, 2002; WQC Number 3105 issued February 11, 1997; WQC Number 2668 issued January 21, 1992; and WQC Number 1273 issued November 10, 1978. This General Certification is rescinded when the Corps of Engineers reauthorizes any of the corresponding Nationwide and/or Regional General Permits or when deemed appropriate by the Director of the Division of Water Quality.

Water Quality Certification No. 3908

GENERAL CERTIFICATION FOR PROJECTS ELIGIBLE FOR U.S. ARMY CORPS OF ENGINEERS REGIONAL GENERAL PERMIT 198000048 INVOLVING DISPOSAL OF DREDGED MATERIAL ON OCEAN BEACHES WITHIN NORTH CAROLINA

Water Quality Certification Number 3908 is issued in conformity with the requirements of Section 401, Public Laws 92-500 and 95-217 of the United States and subject to the North Carolina Division of Water Quality Regulations in 15 NCAC 02H .0500 and 15 NCAC 02B .0200 for the discharge of fill material to waters and wetland areas which are waters of the United States as described in the Wilmington District's Regional (General) Permit Number 198000048.

The State of North Carolina certifies that the specified category of activity will not violate applicable portions of Sections 301, 302, 303, 306 and 307 of the Public Laws 92-500 and 95-217 if conducted in accordance with the conditions hereinafter set forth.

Activities meeting any one (1) of the following thresholds or circumstances require *written approval* for a 401 Water Quality Certification from the Division of Water Quality (the "Division"):

a) Any proposed fill, dredging, excavation or other modification of waters or wetlands; or
b) Any stream relocation; or
c) Any impact associated with a Notice of Violation or an enforcement action for violation(s) of DWQ Wetland Rules (15A NCAC 02H .0500), Isolated Wetland Rules (15A NCAC 02H .1300), DWQ Surface Water or Wetland Standards, or Riparian Buffer Rules (15A NCAC 02B .0200); or
d) Any impacts to streams and/or buffers in the Neuse, Tar-Pamlico, or Catawba River Basins or in the Randleman, Jordan or Goose Creek Watersheds (or any other basin or watershed with Riparian Area Protection Rules [Buffer Rules] in effect at the time of application) *unless* the activities are listed as "EXEMPT" from these rules or a Buffer Authorization Certificate is issued through N.C. Division of Coastal Management (DCM) delegation for "ALLOWABLE" activities.

In accordance with North Carolina General Statute 143-215.3D(e), written approval for a 401 Water Quality General Certification must include the appropriate fee. If a project also requires a CAMA Permit, then one payment to both agencies shall be submitted and will be the higher of the two fees.

Activities included in this General Certification that do not meet one of the thresholds listed above do not require written approval from the Division as long as they comply with the Conditions of Certification listed below. If any of these Conditions cannot be met, then written approval from the Division is required.

Conditions of Certification:

1. No Impacts Beyond those Authorized in the Written Approval or Beyond the Threshold of Use of this Certification

   No waste, spoil, solids, or fill of any kind shall occur in wetlands, waters, or riparian areas beyond the footprint of the impacts depicted in the Pre-Construction Notification, as authorized in the written approval from the Division or beyond the thresholds established for use of this Certification without written authorization, including incidental impacts. All construction activities, including the design, installation, operation, and maintenance of sediment and erosion control Best Management Practices shall be performed so that no violations of state water quality standards, statutes, or rules occur. Approved plans and specifications for this project are incorporated by reference and are enforceable parts of this permit.

2. Standard Erosion and Sediment Control Practices

   Erosion and sediment control practices must be in full compliance with all specifications governing the proper design, installation and operation and maintenance of such Best Management Practices and if applicable, comply with the specific conditions and requirements of the NPDES Construction Stormwater Permit issued to the site:

   a. Design, installation, operation, and maintenance of the sediment and erosion control measures must be such that they equal or exceed the requirements specified in the most recent version of the *North Carolina Sediment and Erosion Control Manual.* The devices shall be maintained on all construction sites, borrow sites, and waste pile (spoil) projects, including contractor-owned or leased borrow pits associated with the project.

   b. For borrow pit sites, the erosion and sediment control measures must be designed, installed, operated, and maintained in accordance with the most recent version of the *North Carolina Surface Mining Manual.*

   c. Reclamation measures and implementation must comply with the reclamation in accordance with the requirements of the Sedimentation Pollution Control Act and the Mining Act of 1971.

   d. Sufficient materials required for stabilization and/or repair of erosion control measures and stormwater routing and treatment shall be on site at all times.

   e. If the project occurs in waters or watersheds classified as Primary Nursery Areas (PNAs), SA, WS-I, WS-II, High Quality (HQW), or Outstanding Resource (ORW) waters, then the sedimentation and erosion control designs must comply with the requirements set forth in 15A NCAC 04B .0124, *Design Standards in Sensitive Watersheds.*

3. No Sediment and Erosion Control Measures in Wetlands or Waters

   Sediment and erosion control measures shall not be placed in wetlands or waters. Exceptions to this condition require application submittal to and written approval by the Division. If placement of sediment and erosion control devices in wetlands and waters is unavoidable, then design and placement of temporary erosion control measures shall not be conducted in a manner that may result in dis-equilibrium of wetlands, stream beds, or banks, adjacent to or upstream and downstream of the above structures. All sediment and erosion control devices shall be removed and the natural grade restored within two (2) months of the date that the Division of Land Resources (DLR) or locally delegated program has released the specific area within the project.

4. Construction Stormwater Permit NCG010000

   An NPDES Construction Stormwater Permit is required for construction projects that disturb one (1) or more acres of land. This Permit allows stormwater to be discharged during land disturbing construction activities as stipulated in the conditions of the permit. If your project is covered by this permit, full compliance with permit conditions including the erosion & sedimentation control plan, inspections and maintenance, self-monitoring, record keeping and reporting requirements is required. A copy of the general permit (NCG010000), inspection log sheets, and other information may be found at http://portal.ncdenr.org/web/wq/ws/su/npdessw#tab-w .

   The North Carolina Department of Transportation (NCDOT) shall be required to be in full compliance with the conditions related to construction activities within the most recent version of their individual NPDES (NCS000250) stormwater permit.

5. The discharge shall not contain levels of toxic pollutants that would result in a violation of state water quality and wetland standards.

6. If concrete is used during the construction, then all necessary measures shall be taken to prevent direct contact between uncured or curing concrete and waters of the state. Water that inadvertently contacts uncured concrete shall not be discharged to waters of the state due to the potential for elevated pH and possible aquatic life/ fish kills.

7. Construction Moratoriums and Coordination

   If activities must occur during periods of high biological activity (i.e. sea turtle nesting, fish spawning, or bird nesting), then biological monitoring may be required at the request of other state or federal agencies and coordinated with these activities.

   All moratoriums on construction activities established by the NC Wildlife Resources Commission (WRC), US Fish and Wildlife Service (USFWS), NC Division of Marine Fisheries (DMF), or National Marine Fisheries Service (NMFS) to lessen impacts on trout, anadromous fish, larval/post-larval fishes and crustaceans, or other aquatic species of concern shall be implemented. Exceptions to this condition require written approval by the resource agency responsible for the given moratorium.

   Work within the twenty-five (25) designated trout counties or identified state or federal endangered or threatened species habitat shall be coordinated with the appropriate WRC, USFWS, NMFS, and/or DMF personnel.

8. If an environmental document is required under the National or State Environmental Policy Act (NEPA or SEPA), then this General Certification is not valid until a Finding of No Significant Impact (FONSI) or Record of Decision (ROD) is issued by the State Clearinghouse.

9. In the twenty (20) coastal counties, the appropriate DWQ Regional Office must be contacted to determine if Coastal Stormwater Regulations will be required.

10. This General Certification does not relieve the applicant of the responsibility to obtain all other required Federal, State, or Local approvals.

11. The applicant/permittee and their authorized agents shall conduct all activities in a manner consistent with State water quality standards (including any requirements resulting from compliance with §303(d) of the Clean Water Act), and any other appropriate requirements of State and Federal Law. If the Division determines that such standards or laws are not being met, including failure to sustain a designated or achieved use, or that State or Federal law is being violated, or that further conditions are necessary to assure compliance, then the Division may reevaluate and modify this General Water Quality Certification.

12. When written authorization is required for use of this certification, upon completion of all permitted impacts included within the approval and any subsequent modifications, the applicant shall be required to return the certificate of completion attached to the approval. One copy of the certificate shall be sent to the DWQ Central Office in Raleigh at 1650 Mail Service Center, Raleigh, NC, 27699-1650.

13. Additional site-specific conditions, including monitoring and/or modeling requirements, may be added to the written approval letter for projects proposed under this Water Quality Certification in order to ensure compliance with all applicable water quality and effluent standards.

Water Quality Certification No. 3908

14. This certification grants permission to the director, an authorized representative of the Director, or DENR staff, upon the presentation of proper credentials, to enter the property during normal business hours.

This General Certification shall expire on the same day as the expiration date of the corresponding Nationwide and/or Regional General Permit. The conditions in effect on the date of issuance of Certification for a specific project shall remain in effect for the life of the project, regardless of the expiration date of this Certification.

Non-compliance with or violation of the conditions herein set forth by a specific project may result in revocation of this General Certification for the project and may also result in criminal and/or civil penalties.

The Director of the North Carolina Division of Water Quality may require submission of a formal application for Individual Certification for any project in this category of activity if it is determined that the project is likely to have a significant adverse effect upon water quality, including state or federally listed endangered or threatened aquatic species, or degrade the waters so that existing uses of the wetland or downstream waters are precluded.

Public hearings may be held for specific applications or group of applications prior to a Certification decision if deemed in the public's best interest by the Director of the North Carolina Division of Water Quality.

Effective date: March 19, 2012

DIVISION OF WATER QUALITY

By

Matt Matthews for

Charles Wakild, P.E.

Director

History Note: Water Quality Certification (WQC) Number 3908 issued March 19, 2012 replaces WQC 3703 issued November 1, 2007; WQC 3640 issued March 2007; WQC 3493 issued December 2004; and WQC 3372 issued March 18, 2002. This General Certification is rescinded when the Corps of Engineers reauthorizes any of the corresponding Nationwide and/or Regional General Permits or when deemed appropriate by the Director of the Division of Water Quality.

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April 1, 2008

Via First Class Mail and Electronic-Mail

U.S. Army Corps of Engineers
Wilmington District
Attention: Stacy Samuelson (CESAW-TS-PE)
Post Office Box 1890
Wilmington, NC 28402-1890

Re: Comments Regarding Morehead City Harbor Dredged Material Management Plan

Dear Mr. Samuelson:

I am writing on behalf of Carteret County, North Carolina, in response to the United States Army Corps of Engineers' (the "Corps") request for comments regarding the scope of the Dredged Material Management Plan ("DMMP") for the Morehead City Harbor Project ("MCHP"). Carteret County believes that the DMMP should (i) ensure that maintenance dredging activities are performed in an environmentally acceptable manner, (ii) use sound engineering techniques, and (iii) address all dredged material disposal alternatives for the MCHP.

The Corps' current dredged material management practices for the MCHP are not in compliance with federal and state law. As the Corps has recognized, placement of beach-quality dredged material offshore is "neither environmentally acceptable, nor engineeringly sound," "poor management of a limited resource" and "is not consistent with North Carolina's Coastal Zone Management Act regulations." Further, with respect to the placement of dredged material in the nearshore berm, contrary to the Corps' expectation, the material has exhibited little landward movement. The Corps, therefore, must completely re-evaluate its dredged material management practices associated with the MCHP.

The DMMP for the MCHP should be developed using procedures that identify, evaluate, screen and recommend dredged material management alternatives to ensure that such activities are conducted in an environmentally sensitive manner. Specific dredged material management alternatives that must be evaluated include: (i) Brandt Island, (ii) beach disposal and replenishment, (iii) the nearshore berm, and (iv) the Ocean Dredged Material Disposal Site ("ODMDS"). Without fully evaluating each of these alternatives and their environmental impacts and benefits, the DMMP will be inadequate.

The DMMP should focus on new or innovative techniques or policies to meet the Corps' goals of increased beneficial use of dredged material and regional sediment management. The DMMP should encourage and give priority to innovative, non-traditional options that maximize the beneficial use of dredged material. Thus, in identifying dredged material management alternatives to be considered in the DMMP, practices that manage dredged material in a beneficial manner should be the preferred alternatives. Consistent with federal and North Carolina law, such practices include use of dredged material for beach replenishment and disposal in the active nearshore zone at appropriate depths that allow active transport of such material. The following rankings should be used to indicate the preference of each option:

1. Preferred Option. Options that beneficially use dredged material with positive impacts to the environment, including the beaches of Carteret County.

2. Least Preferred Option. Options that have either a low potential for beneficial use and/or potential for unacceptable impacts to the environment, including the beaches of Carteret County.

3. Non-Preferred Option. Options that have potentially unacceptable impacts to the environment or are technically infeasible or are inconsistent with federal or state law.

In evaluating the various dredged material management alternatives, cost may not be a factor in this selection process. Federal law clearly provides that cost or lack of funds is not a basis for failure to be consistent to the maximum extent practical with a state's enforceable policies under the Coastal Zone Management Act ("CZMA"). *See City of Sausalito v. O'Neil*, 386 F.3d 1186, 1223 (9th Cir. 2004)) ("lack of funds is explicitly forbidden as a criterion for finding consistency under 15 C.F.R. § 930.32(a)(3)"); 16 U.S.C. § 1456(c)(1)(B) ("[N]o such exemption shall be granted on the basis of a lack of appropriations unless the President has specifically requested such appropriations and Congress has failed to make them available."); 15 CFR § 930.32(a)(3) ("The only circumstance where a federal agency may rely on a lack of funding as a limitation on being fully consistent with an enforceable policy is the Presidential exemption."). North Carolina's approved Coastal Management Program ("CMP") includes a requirement that beach quality dredged material from navigation channels be used in a beneficial manner wherever practicable and be retained in littoral system to the maximum extent practicable. 15A NCAC §§ 07M.1101 and 07M.1102.

The development of the DMMP should consider federal, state, local and private interests. The DMMP should strive to have regional support from all the stakeholders and incorporate the findings of various other studies that may affect the recommended alternative.

Development of a DMMP, however, is not the end of the process. The potential environmental impacts and benefits of each of the dredged material management alternatives must be fully evaluated in accordance with the National Environmental Policy Act ("NEPA"). Such an analysis would provide widespread public review of the potential impacts of these alternative dredged material management practices. In addition, pursuant to the CZMA, a new consistency determination must be prepared for the recommended alternative. Finally, the DMMP should also be updated periodically to identify any changed conditions.

Carteret County looks forward to working with the Corps to develop an environmentally sound DMMP that not only protects the beaches of Carteret County, but also meets the needs of the Port of Morehead City.

With best wishes,

Sincerely yours,

KILPATRICK STOCKTON LLP

Steven J. Levitas

cc: Greg "Rudi" Rudolph
William "Buck" Fugate
The Honorable Douglas Harris

Samuelson, Stacy D SAW

From: Samuelson, Stacy D SAW

Sent: Friday, February 13, 2009 1:20 PM

To: Angela Mangiameli; 'Assistant County Manager'; 'Atlantic Beach Town Manager'; Bouchard, Jennifer A LT CNRMA; camerons@coastalnet.com; cyndi.karoly@ncmail.net; David Allen (allend@coastalnet.com); 'Don Hoss'; doug.huggett@ncmail.net; 'Gary Collins - EPA'; 'Greg Rudolph'; 'Gregory Case - Deputy Sector Commander USCG'; howard_hall@fws.gov; 'Janice Allen'; 'Jean Preston'; 'Jerry Schill'; joanne.steenhuis@ncmail.net; Jody Merritt (jody.merritt@ncmail.net); smtp-Sutherland, John; 'Katrina Marshall'; 'Linda Brickhouse'; Maria Dunn (maria.dunn@ncwildlife.org); 'Mark Ramsing'; Matthew Godfrey (godfreym@coastalnet.com); 'Mayor Morehead City'; Michael Marshall (mike.marshall@ncmail.net); smtp-Rikard, Michael; 'Morehead City Manager'; 'Pat McElraft'; 'Pete Benjamin - USFWS'; Rich Carpenter; 'Richard Lawrence'; 'Rick Luettich'; 'Roessler, Todd'; smtp-Sechler, Ron; smtp-Winslow, Sara; Stephen Rynas (stephen.rynas@ncmail.net); Todd Walton (todd_walton@ncports.com); 'Town Manager Beaufort'; 'Town Manager Emerald Isle'; 'Town Manager Swansboro'; 'Town of Atlantic Beach CAMA'; 'Tracy Barnes'; Trish Murphey (trish.murphey@ncmail.net); Walker Golder

Subject: FW: Morehead City Harbor Project Dredged Material Management Plan Meeting March 4, 2009

All,

My apologies for sending this twice, but it was brought to my attention that the subject line had the wrong date for the meeting. The meeting date is Wednesday March 4, 2009. Sorry about any confusion this may have caused.

Stacy Samuelson
Biologist
Environmental Resources Section
U.S. Army Corps of Engineers, Wilmington District
69 Darlington Avenue
Wilmington, North Carolina 28403
910-251-4480
910-251-4744(fax)

From: Samuelson, Stacy D SAW
Sent: Friday, February 13, 2009 12:06 PM
To: Angela Mangiameli; 'Assistant County Manager'; 'Atlantic Beach Town Manager'; Bouchard, Jennifer A LT CNRMA; camerons@coastalnet.com; cyndi.karoly@ncmail.net; David Allen (allend@coastalnet.com); 'Don Hoss'; doug.huggett@ncmail.net; 'Gary Collins - EPA'; 'Greg Rudolph'; 'Gregory Case - Deputy Sector Commander USCG'; howard_hall@fws.gov; 'Janice Allen'; 'Jean Preston'; 'Jerry Schill'; joanne.steenhuis@ncmail.net; Jody Merritt (jody.merritt@ncmail.net); smtp-Sutherland, John; 'Katrina Marshall'; 'Linda Brickhouse'; Maria Dunn (maria.dunn@ncwildlife.org); 'Mark Ramsing'; Matthew Godfrey (godfreym@coastalnet.com); 'Mayor Morehead City'; Michael Marshall (mike.marshall@ncmail.net); smtp-Rikard, Michael; 'Morehead City Manager'; 'Pat McElraft'; 'Pete Benjamin - USFWS'; Rich Carpenter; 'Richard Lawrence'; 'Rick Luettich'; 'Roessler, Todd'; smtp-Sechler, Ron; smtp-Winslow, Sara; Stephen Rynas (stephen.rynas@ncmail.net); Todd Walton (todd_walton@ncports.com); 'Town Manager Beaufort'; 'Town Manager Emerald Isle'; 'Town Manager Swansboro'; 'Town of Atlantic Beach CAMA'; 'Tracy Barnes'; Trish Murphey (trish.murphey@ncmail.net); Walker Golder
Cc: Owens, Jennifer L SAW; Payonk, Philip M SAW; Frabotta, Christopher C SAW; McCorcle, Justin P SAW
Subject: Morehead City Harbor Project Dredged Material Management Plan Meeting Feb. 25, 2009

All,

As you may be aware, the U.S. Army Corps of Engineers, Wilmington District, is initiating the process to develop the "Morehead City Harbor Dredged Material Management Plan". The 20-year plan will identify how dredge material, originating from the Morehead City Harbor Federal navigation project, will be managed in a least cost, environmentally acceptable and engineeringly sound manner.

The Wilmington District has performed a substantial amount of preliminary work, including: geotechnical sampling and analysis, determination of shoaling and dredging rates, etc. which should help with the identification of alternatives. This preliminary work will be utilized to develop and evaluate "disposal alternatives" for the plan.

We would like to meet with our Local, State and Federal agency partners to discuss the following:

- Provide a status briefing of the completed work and the ongoing work.
- Provide the major milestones of the project schedule.
- Request input from Local, State and Federal agencies on identification of potential alternatives.
- Request input from Local, State and Federal agencies on constraints or preferences that may affect choice of alternatives.

We have scheduled a meeting to discuss these items. Below is the proposed time and location:

Time / Date: 1300 - 1500 / 4 March 2009 (Wednesday)

Location: Carteret County Commissioners Boardroom, Courthouse Square, Beaufort, NC 28516

Please respond to Mr. Stacy Samuelson (stacy.d.samuelson@usace.army.mil) by 25 February 2009 if you plan to attend or have questions. Please forward this announcement to any additional interested parties as you see fit. Thank you in advance for your participation in this project.

V/R,

Mr. Stacy Samuelson
Biologist
Environmental Resources Section
U.S. Army Corps of Engineers, Wilmington District
69 Darlington Avenue
Wilmington, North Carolina 28403
910-251-4480
910-251-4744(fax)

DEPARTMENT OF THE ARMY
WILMINGTON DISTRICT, CORPS OF ENGINEERS
69 DARLINGTON AVENUE
WILMINGTON, NORTH CAROLINA 28403-1343

REPLY TO
ATTENTION OF:

July 31, 2009

Environmental Resources Section

Mr. Russell J. Wilson, Superintendent
Cape Lookout National Seashore
131 Charles Street
Harkers Island, North Carolina 28531

Dear Mr. Wilson:

The purpose of this letter is to request the position of your agency regarding the disposal of sediment associated with dredging of the navigation channels of the Morehead City Harbor Project (MCHP), which lies adjacent to Shackleford Banks, part of the Cape Lookout National Seashore (CALO), in Carteret County, North Carolina. Specifically, this agency is preparing a 20-year Dredged Material Management Plan (DMMP) to identify disposal locations that are cost-effective, engineeringly sound, and environmentally acceptable for material dredged from the project. We are now in the alternatives formulation phase of the DMMP process, and are considering a wide range of alternatives for dredged material disposal, some of which involve the placement of material on or near the beaches of Shackleford Banks. Before this agency advances any of these alternatives to a final grouping of probable or likely disposal locations, we would like to solicit the opinion of your agency regarding the compatibility of such disposal alternatives with the purposes of the National Seashore. Additionally, we would like to obtain from you a basic understanding of the criteria, data, or objectives that your agency would like to see considered as we evaluate alternatives, particularly those that may involve placement of material on or near the National Seashore.

The MHCP has been a continuously maintained Federal navigation project since 1911. Currently, the Corps of Engineers maintains a system of navigation channels that leads from the deep water of the Atlantic Ocean to the State Port of Morehead City and beyond. The project, as outlined in the enclosure 1, contains material with a range of grain sizes from 50 percent to 90 percent sand. The Corps is considering a wide range of disposal options for this material, including the beaches of Bogue and Shackleford Banks, the nearshore areas adjacent to both islands, and confined upland disposal areas that currently exist or may be developed. A goal of the dredged material disposal project is to, where practicable, counteract the erosive effects of channel maintenance, a major element of which is the deflation of the ebb tide delta of Beaufort Inlet.

Recent Corps analysis of Beaufort Inlet surveys indicates that between 1974 and 2009, the inlet's ebb tide delta has deflated by approximately 13,400,000 cubic yards (cy). As the enclosed elevation difference plot shows at enclosure 2, some of the most dramatic changes in depth have occurred on the smaller eastern side of the delta, adjacent to Shackleford Banks. As a result, the Corps is exploring the creation of a new nearshore disposal area for dredged material on the eastern side of the delta, with the expectation that such placement may counteract delta deflation. The proposed location for the disposal area is included as enclosure 3 to this letter, and measures approximately 413 acres adjacent to the western side of the island. The amounts of material placed, proposed grain size, and disposal interval are yet to be determined. Some further clarification of this proposed area, and the material proposed to be disposed in it, will be available following our sampling effort that will characterize the existing ebb tide delta substrate and benthos across a large portion of the delta.

In its initial Environmental Impact Statement for deepening of the MCHP in 1976, the Corps approached CALO regarding the potential for placement of material on Shackleford Banks to counteract anticipated erosion. At that time, your agency indicated that it did not desire dredged material disposal on Shackleford Banks. We would appreciate your current opinion on dredged material disposal on Shackelford Banks. As shown in enclosure 4, the Corps is currently developing an alternative that includes an area that begins approximately one mile east of Beaufort Inlet and terminates six miles east of the inlet. This area is within the westerly transport zone identified in the Corps' Section 111 report from June 2001. Proposed berm width and timing of placement is yet to be determined. If CALO prefers not to accept disposal of dredged material on Shackelford Banks, we would appreciate a written response to that effect, as development of this alternative may be resource intensive.

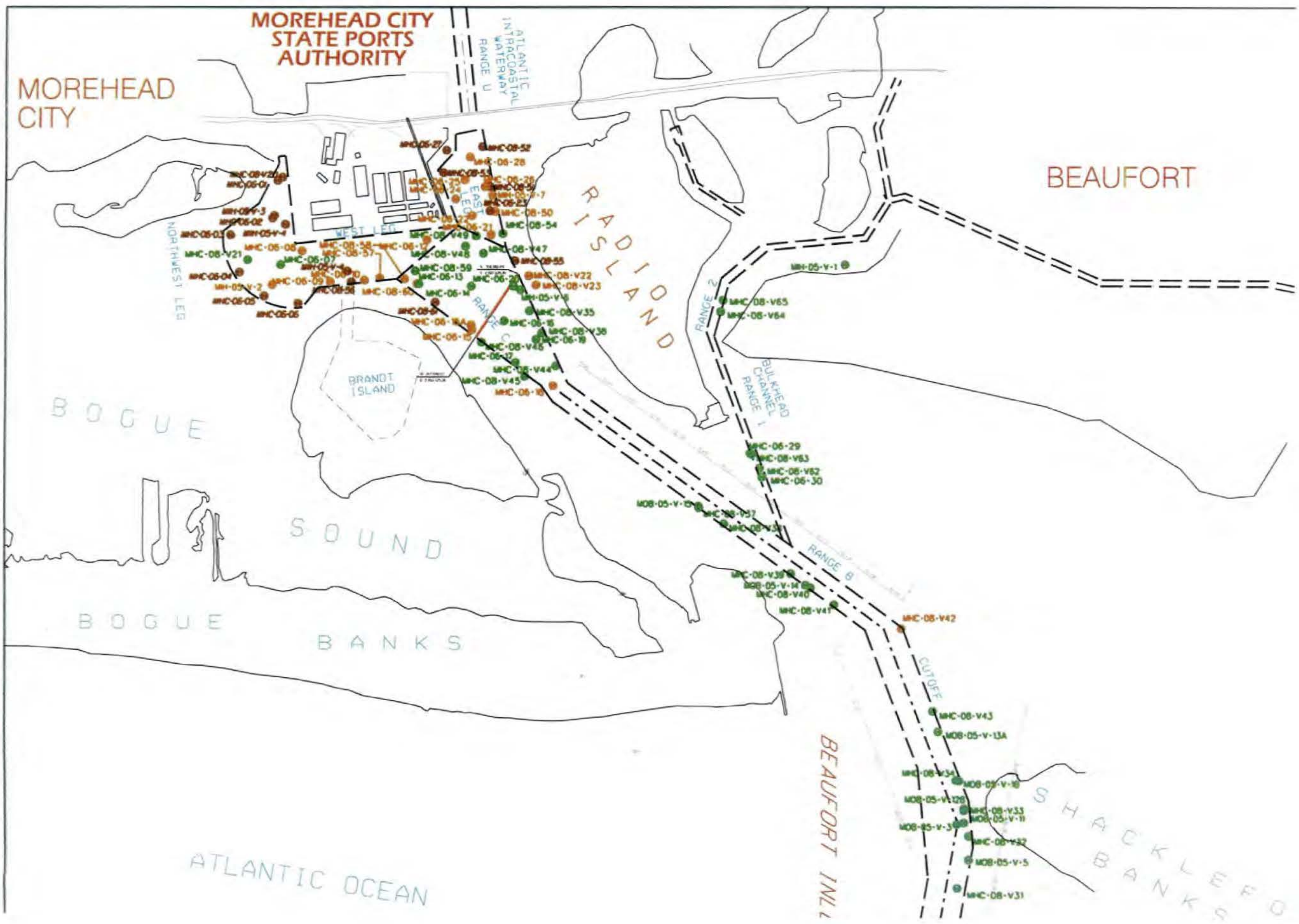
We would also like to obtain from you a basic understanding of the criteria, data, or objectives that your agency would like to see considered as we evaluate alternatives, particularly those that may involve placement of material on or near the National Seashore. We invite your active participation in this ongoing process, and invite you to attend our regular monthly meetings on the DMMP. For more information, or to clarify any matter herein, please contact Ms. Jenny Owens at (910) 251-4757. Thank you for your consideration, and I await your response.

Sincerely,

W. Coleman Long
Chief, Planning and Environmental Branch

Copy Furnished w/encl:

Mr. Michael Rikard
Cape Lookout National Seashore
131 Charles Street
Harkers Island, North Carolina 28531



MOREHEAD CITY STATE PORTS AUTHORITY
MOREHEAD CITY
ATLANTIC INTRACOASTAL WATERWAY
RANGE U
BEAUFORT
RADIO ISLAND
NORTHWEST LEG
WEST LEG
EAST LEG
BRANDT ISLAND
BOGUE SOUND
BOGUE BANKS
RANGE 2
BULKHEAD CHANNEL RANGE 1
RANGE B
CUTOFF
BEAUFORT INL
ATLANTIC OCEAN
MHC-08-V21
MHC-08-V22
MHC-08-V23
MHC-08-V35
MHC-08-V38
MHC-08-V46
MHC-08-V44
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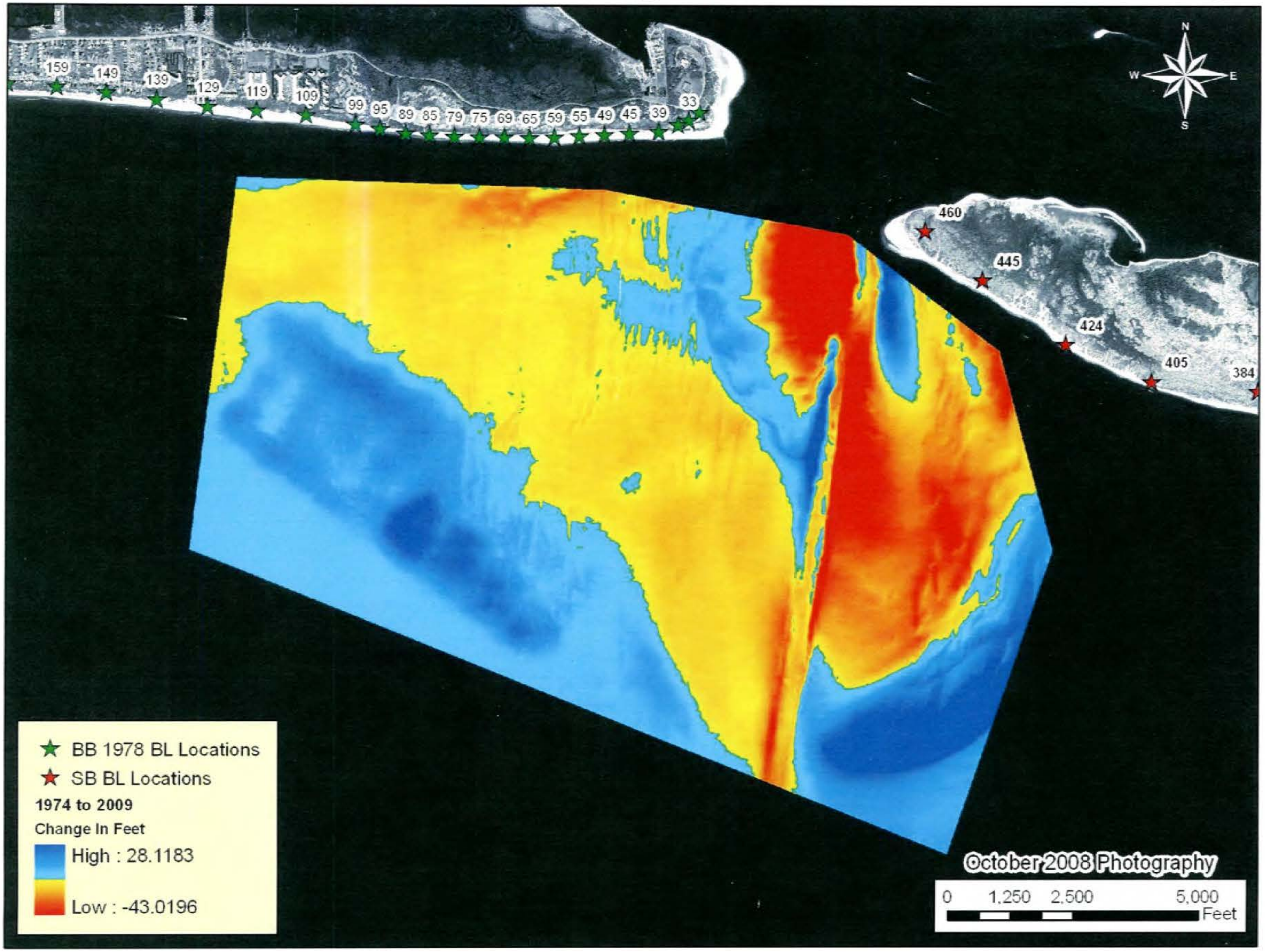
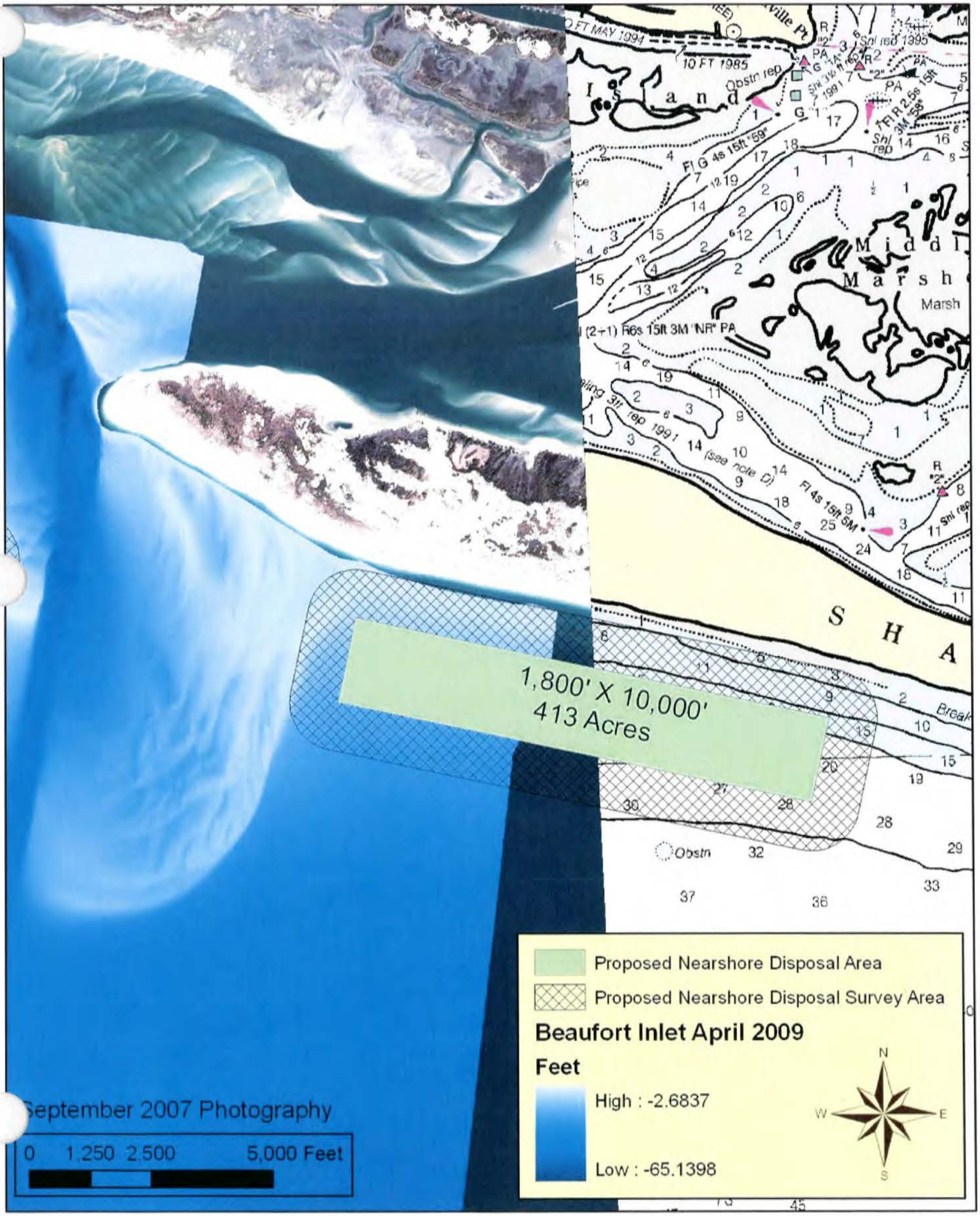
MHC-08-55
MHC-08-54
MHC-08-50
MHC-08-52
MH-05-V-1
MHC-08-V65
MHC-08-V64
MHC-08-29
MHC-08-V63
MHC-08-V62
MHC-08-30
MHC-08-V41
MHC-08-V42
MHC-08-V43
MOB-05-V-13A
MOB-05-V-5
MHC-08-V31

1974 to 2009 Eleva[illegible]n Difference Plot



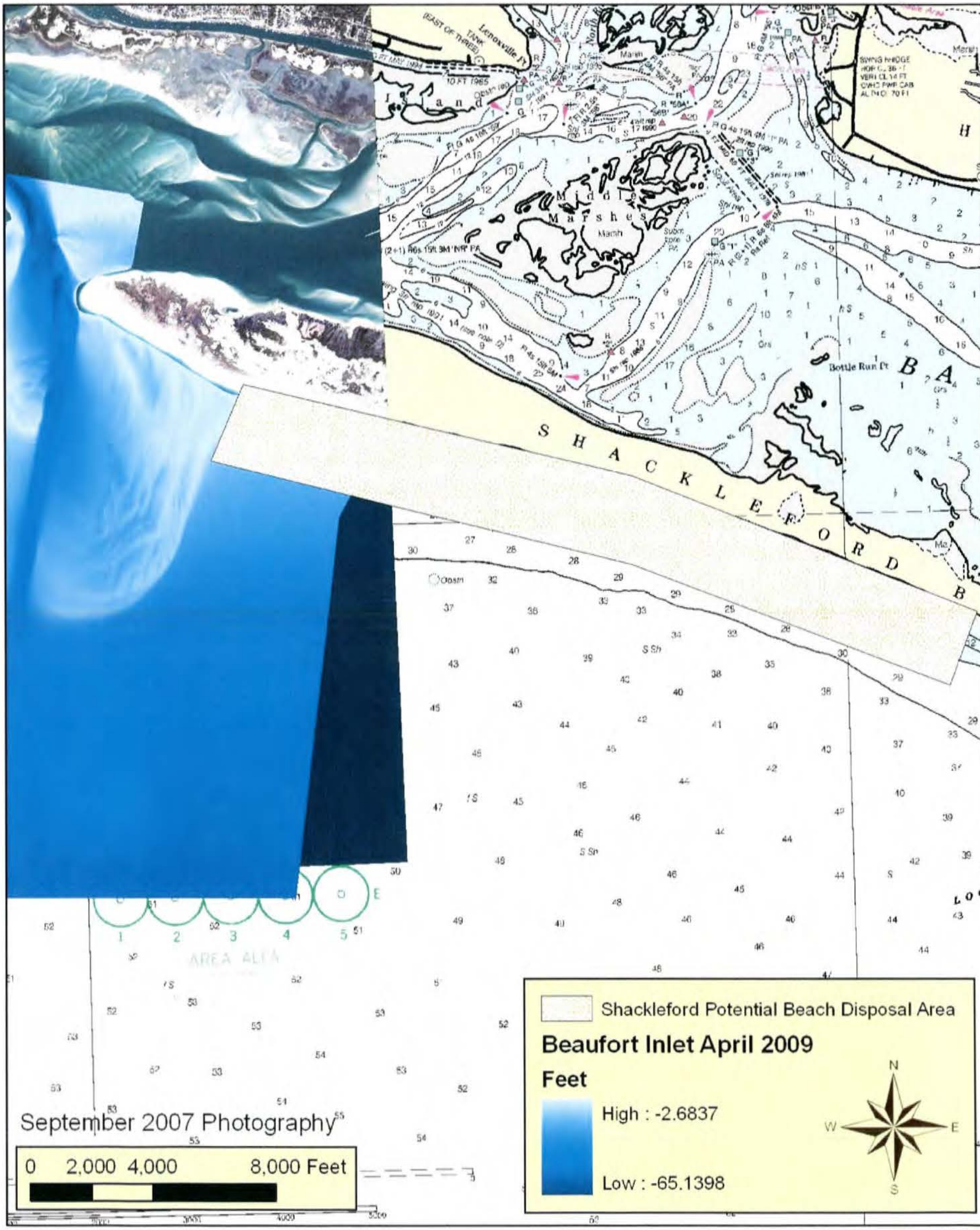
Enclosure 2

Proposed Nearshore Disposal Location



Enclosure 3

Potential Beach Disposal Location



Enclosure 4

United States Department of the Interior

National Park Service
Cape Lookout National Seashore
131 Charles Street
Harkers Island, North Carolina 28531

IN REPLY REFER TO:

A3815

September 24, 2009

Mr. W. Coleman Long
Chief, Planning and Environmental Branch
Department of the Army
Wilmington District, Corps of Engineers
69 Darlington Avenue
Wilmington, North Carolina 28403-1343

Dear Mr. Long:

Thank you for your letter of July 31, 2009, requesting information about the compatibility of sediment disposal with the purposes of Cape Lookout National Seashore (CALO). You also asked for the criteria, data, and objectives that the National Park Service (NPS) would like to see considered in the U.S. Army Corps of Engineers' evaluation of alternatives in the Morehead City Harbor Project Dredged Material Management Plan (MCHP DMMP).

We have addressed your two requests below. We are also requesting additional information from you about this project.

Compatibility with NPS Purposes

As you know, CALO is a unit of the National Park System. It is the policy of the National Park Service to protect natural processes in park units, such as shoreline change. Generally, the NPS disfavors any interference with those processes by actions such as sediment disposal (NPS Management Policies 2006, § 4.8.1 and § 4.8.1.1). Sediment disposal and other types of shoreline process interference are only permitted within national park units when:

Directed by Congress,

Necessary in emergencies that threaten human life and property,

There is no other feasible way to protect park natural resources, cultural resources, or park facilities, or necessary to restore or mitigate the impacts of human-caused activities.

Therefore, to be compatible with the park's purposes, any sediment disposal within CALO must meet one or more of the above requirements. This determination must be based on the results of scientific research, as required by 16 U.S.C. § 5936. Additionally, any sediment disposal within CALO would need to be carried out in accordance with a plan that is acceptable to the NPS and consistent with the park's purposes (see 16 U.S.C. § 459g-5), and a way that ensures that park resources and values remain unimpaired (see 16 U.S.C. § 1).

TAKE PRIDE IN AMERICA

This NPS shoreline policy was applied at CALO in 2006 with the nourishment of the park beach in front of the historic buildings associated with the Cape Lookout Lighthouse. This beach was nourished to mitigate the erosion caused by the maintenance of Barden Inlet and to protect these important cultural resources.

Criteria, Data, and Objectives to be Considered in the MCHP DMMP Alternatives

The above-described NPS policy and mandates will serve as the criteria against which the NPS would compare any DMMP alternative that includes sediment disposal in the Seashore. Initially, data will be required to assess whether placement of dredged material within CALO meets one or more of the above criteria. If the initial investigation indicates that this alternative does meet one or more of the NPS criteria, then further research will be required to consider potential impacts to the natural and cultural resources in the park and provide information for NPS decision-making.

DMMP alternatives that include the disposal of non-beach-quality sediment near the park boundary may likewise result in impacts to park resources. Specifically, the NPS is concerned about the chemical and physical compatibility of such sediment with the existing sediment within the park. On the other hand, the NPS would be willing to consider the nearshore disposal of beach-quality sediment if it were designed to replenish the eroded ebb shoal and/or the deflated offshore profile. Therefore, the DMMP should include information about the source(s), the chemical and physical composition, and the quantity of any sediment proposed for disposal in the nearshore areas along Shackleford Banks, and the intended purpose and justification for placing it there.

Additionally, the DMMP should include information about the intended dimensions and location of the navigation channel through Beaufort Inlet and whether the maintenance of this channel would result in the dredging of areas within park boundaries. The DMMP should note that any such dredging would need to proceed in accordance with NPS mandates for the protection of park resources.

All DMMP alternatives should consider data including, but not limited to, historic and existing beach and nearshore morphology; historic and existing alongshore sediment transport rates and directions; characterization of the nearshore macroinvertebrate communities in the potential disposal areas; and characterization of potential dredge material to ensure that the sediments are free of contaminants and are compatible in grain-size, composition and color with existing beach and nearshore sediments. Establishment of pre-project conditions and post-project monitoring should be included in each alternative. Each alternative must be presented in sufficient detail in the DMMP and the associated compliance documentation to enable CALO to fully assess the beneficial and adverse impacts of that alternative on the park.

The objective that should be considered in all MCHP DMMP alternatives is the conservation of park resources and values unimpaired for the enjoyment of current and future generations.

I hope that this letter satisfactorily responds to your July 31, 2009 requests. If you have any questions, please do not hesitate to contact me at 252-728-2250 ext. 3014.

Sincerely,

Russel J Wilson

Russel J. Wilson,
Superintendent

KILPATRICK
STOCKTON LLP
Attorneys at Law

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Raleigh NC 27612
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Steven J. Levitas
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slevitas@kilpatrickstockton.com

October 1, 2009

Via First Class Mail and Electronic Mail

U.S. Army Corps of Engineers
Wilmington District
Attention: Stacy Samuelson
Post Office Box 1890
Wilmington, NC 28402-1890

Re: Comments Regarding the Interim Operations Plan and the Dredged Material Management Plan, Morehead City Harbor, North Carolina

Dear Mr. Samuelson:

I am writing on behalf of Carteret County, North Carolina to provide comments regarding the Interim Operations Plan (the "IOP") and the Dredged Material Management Plan ("DMMP") for the Morehead City Harbor Project ("MCHP"). We appreciate the Corps' willingness to allow Carteret County to participate on the Project Delivery Team and its openness during the development of the DMMP. Carteret County, however, has several concerns related to the development of the DMMP, which are summarized below.

1. The material disposed in the existing nearshore berm has exhibited little to no movement, and if the Corps intends to use this area after the IOP, a new consistency determination is required.

Initially, in approximately 1992, the Corps proposed to locate the nearshore disposal area along the -18-foot depth contour. The Corps' own analysis indicated that dredged material disposed in water depth of -25-feet or greater will not exhibit significant movement. Despite this conclusion, in approximately 1994, the Corps proposed that the nearshore berm be located west of Beaufort Inlet between the -25 and -30-foot contours. In fact, when disposing dredged material in the nearshore berm, the Corps has placed such material between approximately the -26 and -40-foot contours. The Corps has acknowledged, as reflected in the following excerpts from Corps documents, that this material has exhibited little to no movement.

- "[B]athymetric surveys suggest that aside from flattening slightly over the past several years, [the nearshore berm] remains generally stable, even though several severe weather events have impacted the area. Bruce Ebersole suggested that the maximum depth of active transport may be 20 feet MLW or less, so that the peaks of the mound are pushed over but the bulk of the mound remains essentially stable." Draft Corps Proposal and Scope of Work – Analysis of Material Movement Nearshore Placement Area, December 10, 2001.

- Dredged material placed in the nearshore berm has exhibited "very little movement." Final Section 111 Report, June 2001, p. 48.

- "The MHC ocean bar dredging job has material placement in the nearshore disposal area, which does not move toward the beach." Internal Corps Email dated October 18, 2005.

- "In fact, this area is the same area where we've been placing material in the nearshore for years that has not moved. (We even have a letter from several years ago from NC DCM asking us why our nearshore berm is not moving.)." Internal Corps Email dated February 24, 2006.

As previously stated, Carteret County does not object to the disposal of dredged material in the existing nearshore berm during implementation of the IOP provided it is limited to a *one-time event* and is superseded by a permanent DMMP that complies with the CZMA and other applicable requirements.

2. In developing the DMMP, the Corps should evaluate the existing and proposed nearshore disposal areas to determine the benefits, if any, of such disposal practices on the ebb tidal delta and adjacent beaches.

It is Carteret County's understanding that the Corps is evaluating a proposal to expand the existing nearshore disposal area off of Bogue Banks and to create a new nearshore disposal area off of Shackleford Banks. The Corps has shown the approximate location of these nearshore disposal areas, but has not defined the specific coordinates or water depths. Nonetheless, based on the approximate location of the proposed nearshore disposal areas, these areas appear be in water depths less than -25 feet MLW. Carteret County supports the Corps efforts to dispose of material in the nearshore disposal area in depths less than -25 feet MLW.

During the development of the DMMP, the Corps should evaluate the movement of dredged material in the existing nearshore disposal area and perform modeling and other tests to predict the potential for movement of dredged material in the expanded and new nearshore disposal areas. In response to concerns raised by the State of North Carolina and Carteret County, in late 2001, the Corps proposed evaluating the existing nearshore disposal area and a shallow water test disposal area. The proposed study included the following tasks:

- Evaluation of the nearshore placement area, inlet and shoreline;

- Wave climate and wave transformation;

- Circulation modeling;
- Sediment transport modeling;
- Field data monitoring;
- Shallow water test mound;
- Recommendations of future placement techniques and locations; and
- Communication of study results and recommendations.

Due to the high cost of the proposal and limited funds, the Corps did not pursue this study. The Corps should use its past experience as a guide in evaluating the existing nearshore disposal area and proposed expansion and creation of new disposal areas during development of the DMMP.

3. Disposal of dredged material in the nearshore berm should not take the place of disposal of beach-quality dredged material directly on the beach and in the proper location.

As the Corps has recognized, it is appropriate to dispose of beach-quality dredged material directly on the beach. *See* Corps, Environmental Assessment, Morehead City Harbor Section 933 Project, May 2003, p. E-3 ("When beach quality sand is dredged from navigation projects, it has become common practice of the USACE to make this resource available to beach communities, to the maximum extent practicable. Placement of this sand on beaches merely represents return of material, which eroded from beaches, and is, therefore, replenishment with native material."). However, not only must such material be placed directly on the beaches, this material must also be placed in the proper location.

During the first year of the IOP, the Corps has proposed to place dredged material directly on the beach. The Corps, however, has proposed to place the vast majority of this material east of the nodal point, which will provide little or no benefit to beaches west of the nodal point. The Corps has recognized that as a result of the MCHP, "waves now have the potential to transport greater volumes of littoral sediment into Beaufort Inlet compared to the pre-project case" and "[e]ssentially all of the material placed on the Fort Macon shoreline in 1978 and 1994 appeared to be transported directly into Beaufort Inlet within a few years following disposal." Corps, Final Section 111 Report, pp. 29, 42-45. Further, one of the factors that the Corps uses to evaluate its dredged material management practices under the Federal Standard is "minimizing losses into the entrance channel." Internal Corps Email, Oct. 16, 2002. Thus, not only does placement of dredged material east of the nodal point provide little or no benefit to the beaches west of the nodal point, it is also inconsistent with the Corps' interpretation of its own regulations.

The Corps should evaluate a number of potential impacts that the MCHP may be causing west of the nodal point. As discussed above, the MCHP has increased the potential for sand to be transported back to Beaufort Inlet; therefore, there is likely less sand available for beaches west of the nodal point compared to pre-project conditions. Not only is there less sand available in the system, research indicates that the MCHP has the potential to increase wave energy and erosion rates during major storm events as far west as eight (8) miles west of Beaufort Inlet. Past wave transformation analyses conducted by the Corps have not focused on individual storm events. Model results from Olsen Associates, Inc. suggest several points alongshore in the vicinity of Pine Knoll Shores where small reversals and erosional hot-spots are indicated. During development of the DMMP, the Corps should evaluate whether the MCHP has the potential to impact erosion rates of areas west of the nodal point during major storm events.[1] Finally, the Corps has acknowledged that the nearshore off of Pine Knoll Shores is steeper than off of Atlantic Beach, which may result in shoreline impacts. Internal Corps Email, Oct. 16, 2002. ("A 50-ft berm would also provide minimal benefit for Pine Knoll Shores. Because the nearshore is so steep, the unit volume required for constructing a 50-ft berm is more than twice that required for a similar berm width for most of Atlantic Beach."); Internal Corps Document, Mike Wutkowski, Feb. 2002 ("There is an import[ant] issue here beyond [whether] or not the disposal berm is moving. (There has been no study on whether the berm has moved.) ERDC has pointed out that the effects of dredging may still be coming. The process is the ocean bar deflates, the offshore deepens and the shoreline adjusts to the deepening. The locals have asked bout this. . . . Headquarters said they are unconcerned about offshore effects. We should get this in writing and be sure they understand that it may indicate a shoreline impact.").

Carteret County has previously provided comments expressing its concerns that more dredged material should be placed west of the nodal point. Carteret County, however, does not object to the disposal of dredged material on the beach in its proposed location during implementation of the IOP provided it is limited to a *one-time event* and is superseded by a permanent DMMP that adequately evaluates the impacts of the MCHP west of the nodal point. Further, the Corps should use placement of sand directly on the beaches of Bogue Banks during the first year of the IOP as an opportunity to evaluate the movement of dredged material placed in this location. In addition to monitoring beach profiles before and after placement of the dredged material, the Corps should collect additional data on sediment movement by performing a tracer study.

4. The Corps should establish specific disposal controls, conditions and requirements for the potential disposal of non-beach quality dredged material in the ODMDS to avoid or minimize potential impacts to beach-quality dredged material previously disposed in the ODMDS.

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[1] When conducting wave transformation analyses, the model grid within the surf zone should be finer in the cross-shore direction to accurately predict where waves are breaking.

Carteret County addresses this issue in comments provided to the Corps regarding the draft Site Management and Monitoring Plan ("SMMP") in a letter dated September 29, 2009. A copy of this letter is attached.

Thank you again for the opportunity to provide these comments. Carteret County looks forward to working with the Corps to ensure that they are appropriately addressed in the DMMP.

With best wishes,

Sincerely yours,

KILPATRICK STOCKTON LLP

Attachment

Steven J. Levitas

cc: Greg "Rudi" Rudolph
William "Buck" Fugate
Justin McCorcle
Chris Frabotta
Coleman Long

REC'D 12/3/1[illegible]

United States Department of the Interior

NATIONAL PARK SERVICE
Southeast Regional Office
Atlanta Federal Center
1924 Building
100 Alabama St., SW.
Atlanta, Georgia 30303

IN REPLY REFER TO:
SER-PC

DEC 02 2010

W. Coleman Long
Chief, Planning and Environmental Branch
Department of the Army
Wilmington District, Corps of Engineers
69 Darlington Avenue
Wilmington, North Carolina 28403-1343

Dear Mr. Long:

The U.S. Army Corps of Engineers (USACE) has inquired whether the National Park Service (NPS) wishes the USACE to expand the scope of its Morehead City Harbor Project Dredged Material Management Plan (MCHP DMMP) to include an additional alternative that may benefit Cape Lookout National Seashore (Seashore). Specifically, the USACE has proposed an alternative that would allow the placement of dredged material at eroding areas of the Shackleford Banks section of the Seashore. The placement of dredged material would mitigate impacts of the MCHP on Shackleford Banks by filling in the steepened beach profiles in the central and western portion of this area. After a review of policy as it relates to Shackleford Banks, the NPS has determined that such an alternative, appropriately implemented, would be consistent with bureau policy and should be included in the DMMP and associated environmental impact statement (EIS).

The NPS is pleased that the USACE has recognized this opportunity to mitigate ongoing impacts associated with maintenance dredging of the MCHP. The management policies of the NPS provide that natural resources are to be managed to preserve fundamental physical and biological processes, as well as individual species, features, and plant and animal communities. Accordingly, NPS typically will not interfere in natural biological or physical processes to conduct active management. However, an exception to this policy is recognized when intervention is necessary to restore natural resource functioning that has been disrupted by past or ongoing human activities. This exception can even apply in those areas, such as Shackleford Banks, that are proposed for designation as wilderness.

Shackleford Banks has been managed to preserve its wilderness resources and values since January 14, 1986. On that date, NPS Director William Penn Mott, Jr., signed a wilderness recommendation proposing that Congress designate 2,990 acres of the island as wilderness. Because Shackleford Banks is proposed wilderness, active manipulation of the island's environment is not normally permitted. However, our management policies allow for intervention in wilderness areas to the extent necessary to correct past mistakes, the impacts of human use, and influences outside of wilderness boundaries.

The NPS has special expertise with respect to the project's potential environmental impacts at the Seashore, and for this reason, we ask that NPS be named a federal cooperating agency on this project. As a cooperating agency, we can offer early review and comment on EIS draft sections in areas of NPS mandates, as well as help prepare those portions of the document, such as the Minimum Requirements Analysis for Wilderness (MRA), that lie particularly within our knowledge and expertise. The NPS manages wilderness in such a way as to maintain its natural, untrammeled and undeveloped qualities, while providing opportunities for solitude and a primitive and unconfined type of recreation. The MRA process is designed to identify those tools and measures that will accomplish the objectives of the project while minimizing impacts on wilderness resources and values.

In addition to taking the foregoing steps, the NPS proposes to assist the USACE in development of the EIS in the following manner:

- Assist in the development and/or review of any monitoring plans or adaptive management plans that might be required
- Provide comments on working drafts of the EIS documents
- Respond to other USACE requests for information
- Participate in public meetings, as appropriate

The NPS's cooperating agency status and level of involvement would not preclude our independent review and comment responsibilities under Section 102(2)(C) of the National Environmental Policy Act. Similarly, our being a cooperating agency would not imply that NPS would necessarily concur with all aspects of the USACE's EIS.

If the proposed alternative were to become the USACE's selected alternative, no actual deposition of sediment could take place at Shackleford Banks until NPS had signed a decision document authorizing such deposition. Assuming no material disagreements among our respective agencies with respect to environmental impacts, the NPS's standard practice would be to adopt relevant parts of the DMMP EIS to provide the necessary compliance for this decision document.

The proposed alternative represents a significant opportunity to address ongoing erosion issues at Shackleford Banks and protect vitally important natural and wilderness resources for future generations. We appreciate your coordination with us and look forward to working with the USACE on this important project.

The primary NPS contact for the overall EIS and NEPA-related issues will be Michael Rikard ((252) 728-2250 x3012). The NPS technical contact for dredging and beach placement related issues will be Jodi Eshleman ((215) 597-1782).

Sincerely,

For David Vela
Regional Director
Southeast Region

cc: Russell J. Wilson, Superintendent, Cape Lookout National Seashore

DEPARTMENT OF THE ARMY
WILMINGTON DISTRICT, CORPS OF ENGINEERS
69 DARLINGTON AVENUE
WILMINGTON, NORTH CAROLINA 28403-1343

REPLY TO
ATTENTION OF:

February 15, 2011

Environmental Resources Section

Mr. David Vela, Regional Director
National Park Service, Southeast Regional Office
Atlanta Federal Center, 1924 Building
100 Alabama St., SW.
Atlanta, Georgia 30303

Dear Mr. Vela:

In response to National Park Service (NPS) letter dated December 2, 2010, the U.S. Army Corps of Engineers, Wilmington District (USACE) formally names the National Park Service as a Federal cooperating agency on the Morehead City Harbor Dredged Material Management Plan and integrated Environmental Impact Statement (DMMP/EIS). The NPS has special expertise with respect to the project's potential environmental impacts at Shackleford Banks, which will be invaluable for our successful completion of the DMMP/EIS. We appreciate your willingness to serve as a cooperating agency in the preparation of this plan; this letter serves as an outline of each agency's responsibilities in the planning process.

The USACE proposes to undertake the following activities to maximize this interagency cooperation:

- Invite the NPS to all relevant coordination meetings;
- Consult with the NPS on any relevant technical studies that will be required for the DMMP/EIS;
- Organize joint field reviews with appropriate NPS staff;
- Provide NPS with pertinent project information, including study results and a detailed project schedule that will identify project milestones;
- Encourage NPS to use the above documents, or other documents which it chooses to provide, to express its views on subjects within its jurisdiction or expertise; and
- Include information in the project environmental documents that cooperating agencies will need to discharge their National Environmental Policy Act (NEPA) responsibilities and any other requirements regarding jurisdictional approvals, permits, licenses, and/or clearances.

As outlined in the letter of December 2, 2010, we understand that, as a cooperating agency, the NPS will provide early review and comment on EIS draft sections in areas of NPS mandates, and will help prepare those portions of the document, such as the Minimum Requirements Analysis for Wilderness (MRA), that lie particularly within the agency's knowledge and expertise. In addition, the NPS will assist the USACE in development of the DMMP/EIS in the following manner:

- Provide assistance and guidance in the development and/or review of any monitoring plans or adaptive management plans that might be required;
- Provide comments on working drafts of the DMMP/EIS documents within agreed-upon timeframes;
- Respond to other USACE requests for information in a timely manner; and
- Participate in public meetings, as appropriate.

It is understood that the NPS's cooperating agency status and level of involvement will not preclude its independent review and comment responsibilities under Section 102(2)(C) of the National Environmental Policy Act. Similarly, it is understood that being a cooperating agency does not imply that NPS will necessarily concur with all aspects of the Corps' DMMP/EIS. It is our goal, however, to seek concurrence between our agencies on all matters of importance to our respective agencies.

The NPS has the right to expect that the DMMP/EIS will enable it to discharge its jurisdictional responsibilities. If the proposed alternative for beach placement of material on Shackleford Banks was to become the Corps' selected alternative, no actual deposition of sediment would take place at Shackleford Banks until NPS signs a decision document authorizing such deposition. We expect that at the end of the National Environmental Policy Act (NEPA) process, the NPS will adopt relevant parts of the DMMP/EIS to provide the necessary compliance for this decision document. The Corps intends to utilize the DMMP/EIS, in its entirety, and the subsequent record of decision as our decision making documents.

We look forward to working with you on this important project. If you have any questions or would like to discuss in more detail the project or our agencies' respective roles and responsibilities during the preparation of the DMMP/EIS, please contact Ms. Jenny Owens, Environmental Resources Section, at 910-251-4757.

Sincerely,

Elden Gatwood

Elden Gatwood
Chief, Planning and Environmental Branch

APPENDIX E

EXPLANATION OF VERTICAL DATUM

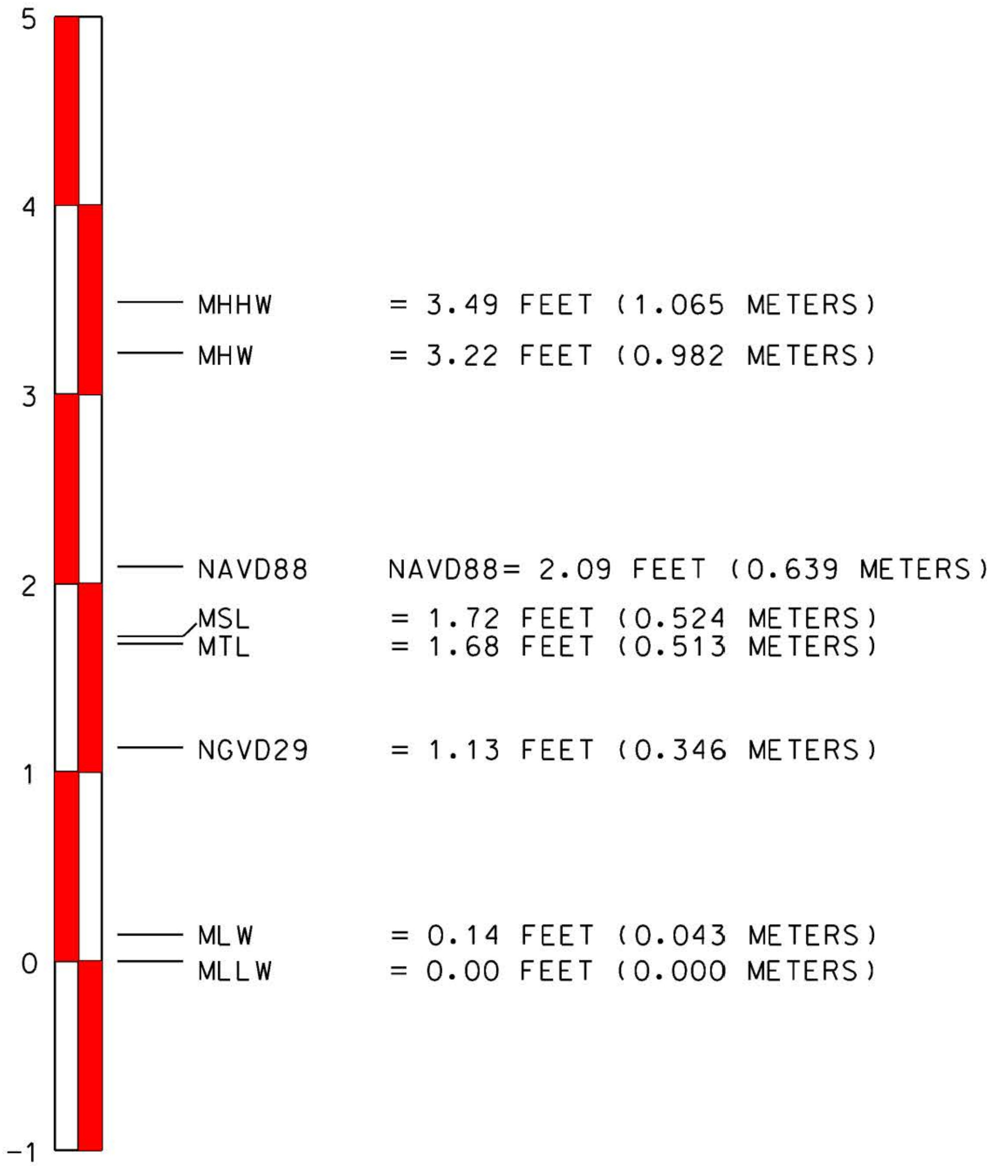
VERTICAL DATUM

A vertical datum is used for measuring the elevations of points on the earth's surface. Vertical data are either tidal, based on sea levels, gravimetric, based on a geoid, or geodetic, based on the same ellipsoid models of the earth used for computing horizontal datums.

In common usage, elevations are often cited in height above sea level; this is a widely used tidal datum. Because ocean tides cause water levels to change constantly, the sea level is generally taken to be some average of the tide heights. Mean lower low water — the average of the lowest points of a semi-diurnal tide reached on each day during a measuring period of several years — is the datum used for measuring water depths on some nautical charts, for example; this is called the chart datum. While the use of sea-level as a datum is useful for geologically *recent* topographic features, sea level has not stayed constant throughout geological time, so is less useful when measuring very long-term processes.

A geodetic vertical datum takes some specific zero point, and computes elevations based on the geodetic model being used, without further reference to sea levels. Usually, the starting reference point is a tide gauge, so at that point the geodetic and tidal datums might match, but due to sea level variations, the two scales may not match elsewhere. One example of a geoid datum is NAVD88, used in North America, which is referenced to a point in Quebec, Canada.

The graphic below shows the relationship between the various vertical datums for the Morehead City Harbor, NC tidal bench mark.



Elevation Information, Station ID #8656502, Morehead City Harbor, NC

APPENDIX F

MOREHEAD CITY HARBOR
MONITORING PLAN

MOREHEAD CITY HARBOR MONITORING PLAN

U.S. ARMY CORPS OF ENGINEERS
WILMINGTON DISTRICT

September 2013

MOREHEAD CITY HARBOR MONITORING PLAN

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Morehead City Harbor Monitoring Plan

<u>Introduction</u>: The Dredge Material Management Plan (DMMP) developed for the Morehead City Harbor and Navigation channel includes provisions for periodic placement of littoral material removed from Inner Harbor and the ocean entrance channel. Disposal of this material may occur in several locations including disposal on the beach along Bogue and Shackleford Banks, placement in the nearshore placement areas within the ebb tide delta, disposal in the Ocean Dredge Material Disposal Site (ODMDS), or Brandt Island. Disposal of material along Bogue Banks will occur within the region shown on Figure 1, approximately covering a 10 mile section of the eastern end of the island between stations 59 and 107. Specific disposal locations within this area shall be determined at the time of the dredging operation to minimize environmental impacts and maximize benefits while minimizing cost. The disposal location for Shackleford Banks is shown in Figure 2 to be between stations 229 and 424. Figure 3 displays the locations where placement within the nearshore environment will occur. These locations include the existing and new nearshore placement areas on the west (Bogue) side of the ebb tide delta and the new nearshore placement area on the east (Shackleford) side of the ebb tide delta. Also included in Figure 3 is the ODMDS location which is used for disposal of non beach quality material, as well as disposal of beach compatible dredged material where weather conditions are unfavorable for placement in the nearshore area.

The maintenance material disposal plan for the Morehead City Harbor and entrance channel was based on the present understanding of sediment transport/beach response patterns in the vicinity of Beaufort Inlet. Due to the highly variable nature of littoral processes and the uncertainty associated with the occurrence and impact of severe coastal storms; the response of the adjacent beaches, shoaling patterns in the entrance channel, and changes in the ebb tide delta (including the nearshore placement areas) will be observed through a routine monitoring program. The results of this monitoring program will be used to make necessary adjustments in the beach disposal location and volumetric distribution of the littoral material removed from the navigation channel and harbor. In addition, the data collected as part of the monitoring program will be used to feed numerical models. These models, when developed, will provide a more complete picture of the system processes. Also, they will enable evaluation of different “what if” scenarios to determine the effects of future actions within the system such as dredging or sand placement. The use of these modeling tools in combination with the results gathered from the monitoring plan would allow for the best management of the system.

With regard to the history of the shorelines along Bogue and Shackleford Banks, the behavior of these beaches has been documented by various engineering reports conducted by the Corps of Engineers, State of North Carolina, and private consultants. In addition, Carteret County has been monitoring the shoreline of Bogue Banks through repetitive beach profile surveys since 1999 and the shoreline of Shackleford Banks since 2005. The Corps of Engineers will use these existing shoreline data sets in combination with other historic survey data to compare the behavior of the shoreline following the implementation of the DMMP. Accordingly, the results of the comparison of the monitoring data with the data gathered prior to the DMMP implementation can be used to modify the sand distribution in future disposal operations.

Monitoring Program: The monitoring program will focus on the response of four main areas in the vicinity of the Morehead City navigation project. The first is the adjacent beach evolution and how these changes compare with the historic changes along the beaches adjacent to Beaufort Inlet. Second, the monitoring will cover the changes within the ebb tide delta and compare with previous inlet surveys to measure morphologic changes. Third, detailed monitoring of the nearshore placement area will be gathered to aid in determining the location of successive placements within the nearshore area. The fourth area of concentration will be an analysis of the ODMDS. The monitoring plan discussed here is funding dependent and is subject to changes on an annual basis.

A) Bogue Banks Monitoring Plan.

i. **Extent of Coverage.** The beach profile stations used will be the locations established by Carteret County as part of their local monitoring program. The profiles will begin at profile 53 just east of the Emerald Isle town limits and extend through profile 116 located at the far eastern end of the island. The profiles are spaced approximately 800 to 1000 feet apart and include approximately 63 stations covering nearly 53,000 feet of the island.

ii. **Profiles.** Surveys of the onshore portion of the beach profiles will occur two times a year for the first five years of the monitoring program and annually through the remaining 15 years of the DMMP. Surveys will cover the area from the landward limit of the profile line (generally the back toe of the dune) seaward to wading depth (-3 to -5 feet NAVD88). One survey will be conducted in the spring (May or June) and the other in the fall (November or December). Offshore profile surveys will be conducted at the same interval as the onshore profiles and should be scheduled to be gathered within 5 days of the corresponding onshore profiles. The offshore profile surveys will extend seaward variable distances to a depth of -40 feet NAVD88. Offshore profiles within the inlet

(Profiles 113 through 116) shall extend to the west prism line of the navigation channel.

iii. **Aerial Photographs.** Color rectified photography shall be collected on an annual basis near the time of the spring profile survey. Collection may be through satellite imagery or through dedicated flights of the island. The nominal scale of the photography will be 1 inch equals 200 feet.

B) Shackleford Banks Monitoring Plan.

i. **Extent of Coverage.** Beach profile stations for Shackleford Banks were established by the USACE in 1991 and these locations have been used by Carteret County in their monitoring program since 2005. These locations will be used for the collection of future monitoring surveys as part of the DMMP monitoring plan. The existing stations are variably spaced at between 1500 and 2500 feet. The coverage will include the entire island comprised of approximately 46,000 feet which is monitored over 24 profile lines.

iv. **Profiles.** Surveys of the onshore portion of the beach profiles will occur two times a year for the first five years of the monitoring program and annually through the remaining 15 years of the DMMP. Surveys will cover the area from the landward limit of the profile line (generally the back toe of the dune) seaward to wading depth (-3 to -5 feet NAVD88). One survey will be conducted in the spring (May or June) and the other in the fall (November or December). Offshore profile surveys will be conducted at the same interval as the onshore profiles and should be scheduled to be gathered within 5 days of the corresponding onshore profiles. The offshore profile surveys will extend seaward variable distances to a depth of -40 feet NAVD88.

v. **Aerial Photographs.** Color rectified photography shall be collected on an annual basis near the time of the spring profile survey. Collection may be through satellite imagery or through dedicated flights of the island. The nominal scale of the photography will be 1 inch equals 200 feet.

C) Nearshore and Ebb Tide Delta Monitoring Plan.

i. **Ebb Tide Delta.** Current surveys of the ebb tide delta indicate that the delta is deflating on both sides of the navigation channel. Monitoring future changes in the ebb tide delta will be accomplished by surveying the entire delta once every two years for the first two surveys with surveys gathered every third year thereafter through the life of the 20 year DMMP. Specifically surveys should be collected in fiscal year 2015, 2017, 2020, 2023, 2026, 2029, and 2032. The proposed aerial extent of the delta survey coverage is indicated on Figure 4, which includes the nearshore placement area, as well as a portion of the ODMDS. Surveys should provide 100% coverage of the proposed ETD monitoring area.

ii. **Nearshore Placement areas.** Figure 3 displays the nearshore placement areas that will be surveyed on a periodic basis to capture the evolution of the material within the cells. Surveys of the nearshore placement area and the surrounding monitoring area will be taken just prior to placing material within the placement area, as well as just after placement has occurred. At a minimum, a survey will be made annually corresponding to the time of the spring profile surveys on the adjacent beaches. Monitoring surveys of the area will be used to modify future placement designs and should provide 100% coverage of the nearshore placement areas.

iii. **Ocean Dredge Material Disposal Site.** Monitoring of the ODMDS will be accomplished through a combination of the ebb tide delta surveys and specific site surveys. Site specific surveys will be gathered through the Morehead City ODMDS Site Management and Monitoring Plan (SMMP) (USACE, 2009). Surveys obtained through the SMMP will be gathered just prior to disposal of material within the ODMDS as well as just after disposal is complete.

D) Wave and Current Measurements.

Directional Wave Measurements. In addition to the extensive surveying discussed above, a wave gauge is included as an integral part of the monitoring program. The initial location of the gauge will be just offshore of Atlantic Beach in approximately 20 feet of water. After 12 months of data collection at the initial deployment location, the gauge will be moved just offshore of Shackleford Banks at a depth of 20 feet to collect another 12 months of data. Exact location of the gauge will be determined when funding is available based on the existing inlet bathymetry at that time. The bottom-mounted gauge will consist of a combination of an Acoustic Doppler Current Profiler (ADCP) meter and pressure gauge. This combination is capable of producing measurements of wave height, period, direction, and currents over the water column. These measurements will in turn be used to compute potential sediment transport rates necessary for the proper disposal of maintenance material along the beaches.

E) **Data Collection and Monitoring Report.** Raw data collected as a result of the monitoring plan will be made available to any interested party as it becomes available. A report summarizing the monitoring activity will be prepared annually and will include an analysis of the observed changes and trends along the adjacent beaches and a comparison to expected or historical trends. The report will also include an assessment of the shoaling patterns in the entrance channel, changes in the ebb tide delta, and an analysis of the wave measurements. This report will also be provided to Carteret County, the Towns of Atlantic Beach, Pine Knoll Shores, Indian Beach and any other interested party. Each annual report will summarize the data collected during the year and will incorporate data contained in previous monitoring reports.

Numerical Modeling: In addition to the data collection and analysis of the monitoring plan, it is intended to develop a collection of numerical models to be used to simulate the coastal hydrodynamics and sedimentation within and around Beaufort Inlet. This work may be combined with the efforts of the Regional Sediment Management (RSM) program being implemented through the U.S. Army Corps of Engineers, Wilmington District. The RSM program is working toward development of a regional understanding of the sediment processes along the coast of North Carolina. By combining the results of the regional sediment budget developed under the RSM program with the project specific modeling of Beaufort Inlet, the management of the resources within and around Beaufort Inlet should be improved.

A) Regional Circulation Model. Regional water levels and currents during normal and storm conditions will be simulated using the Advanced Circulation model, ADCIRC, (Luettich, et al. 1991). ADCIRC is a hydrodynamic numerical model that simulates water surface elevations and currents from astronomic tidal forcing, wind and barometric pressure fields.

B) Coastal Modeling System. The Coastal Modeling System (CMS) (Buttolph et al. 2006) was developed by the Coastal Inlet Research Program (CIRP) at the U.S. Army Engineer Research and Development Center (ERDC) in Vicksburg, Mississippi. The purpose of the model development was to calculate navigation channel and morphologic change within an inlet complex and its connection to processes on adjacent beaches. The modeling system consists of three main components which operate through the Surface water Modeling System (SMS) interface.

1. **CMS- WAVE** is a steady-state, finite difference, spectral model that simulates depth and current-induced wave refraction and shoaling, depth and steepness-induced wave breaking, diffraction, and wave growth.
2. **CMS-FLOW** is a two-dimensional, finite difference numerical approximation of the depth-integrated continuity and momentum equations. The model will produce high resolution time and space varying water levels, velocity fields, sediment transport rates, and bathymetric changes.
3. **CMS-PTM** is the Particle Tracking Model (PTM) which is forced by a combination of the CMS-WAVE and CMS-Flow models. The PTM can be used to isolate and track specific sources of sediment, monitor sediment sources impacting inlets, predict potential turbidity impacts, and track and predict sediment fate.

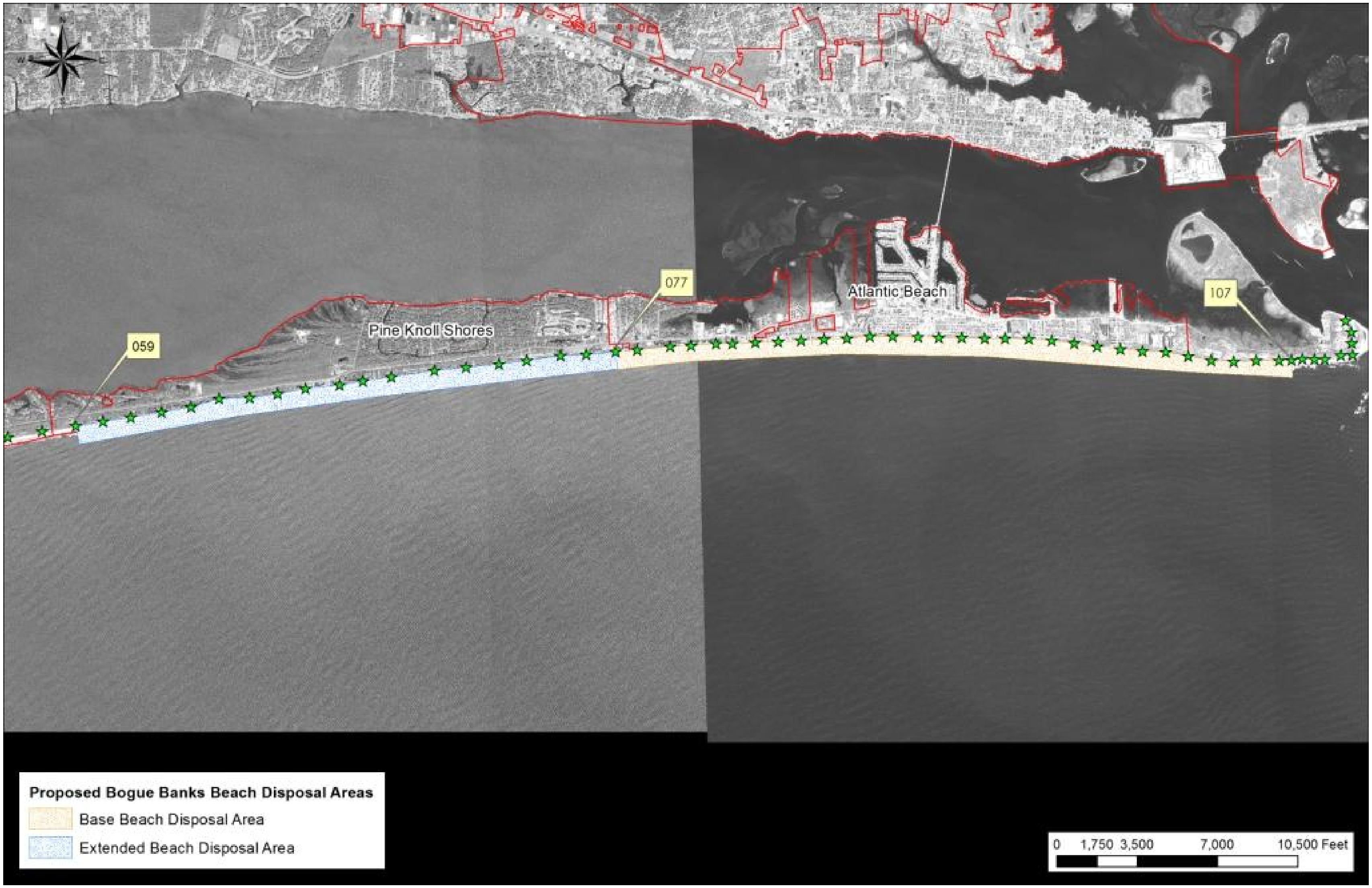

Figure 1. Beach Disposal Locations Along Bogue Banks

Figure 2. Beach Disposal Location Along Shackleford Banks

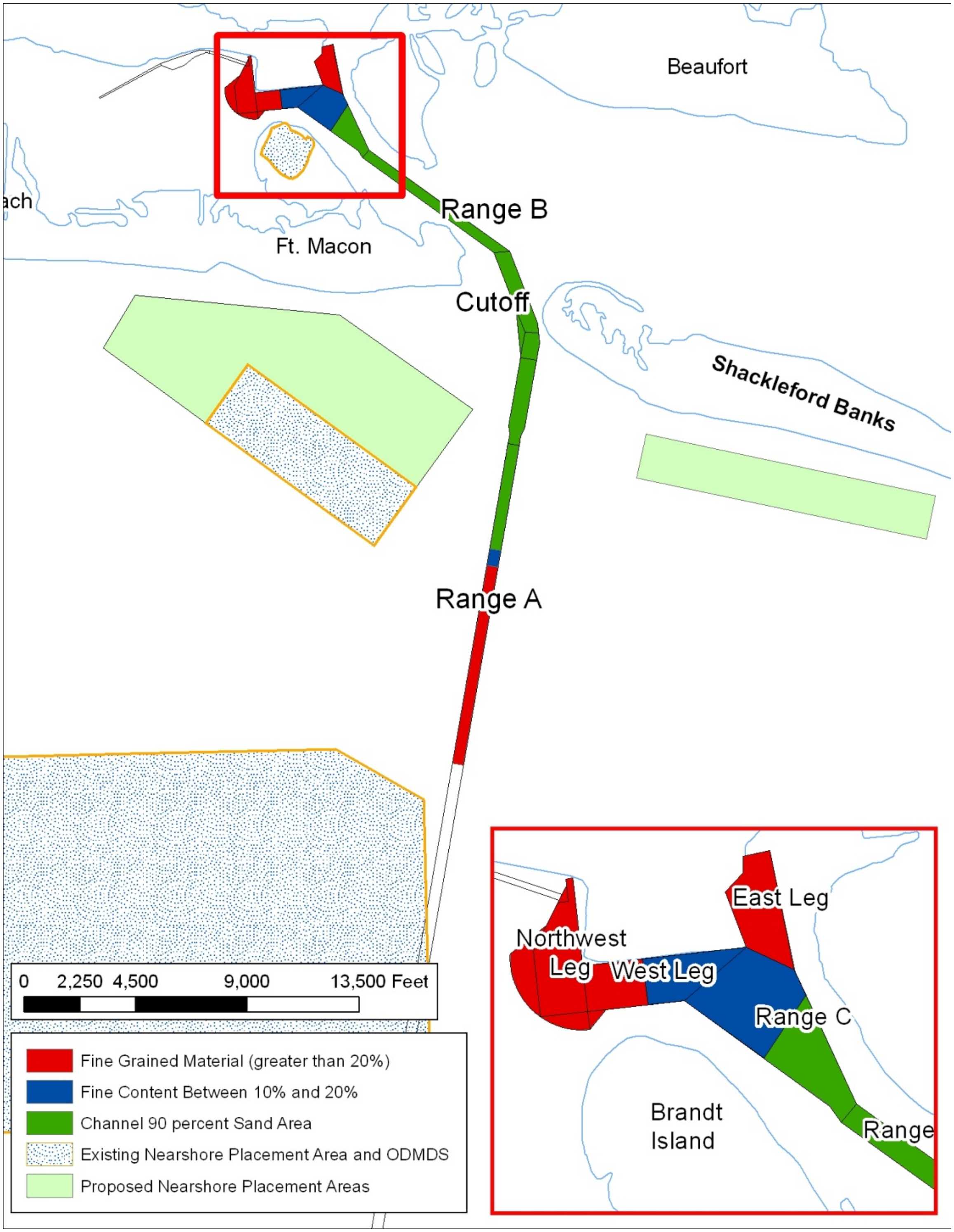

Figure 3. Nearshore Placement and ODMDS Disposal Locations

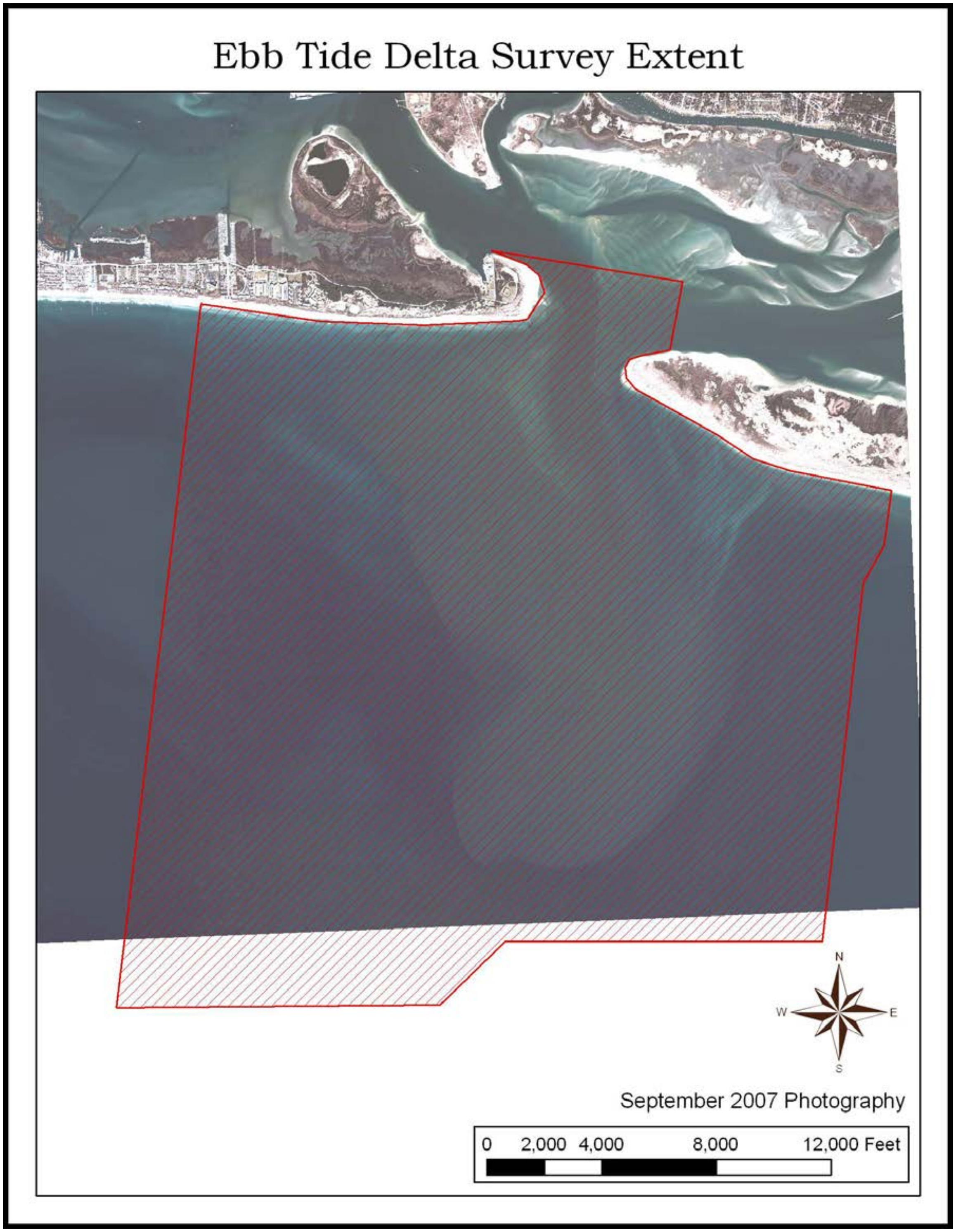

Figure 4. Ebb Tide Delta Survey Extent

Beaufort Inlet Grab Sample Locations

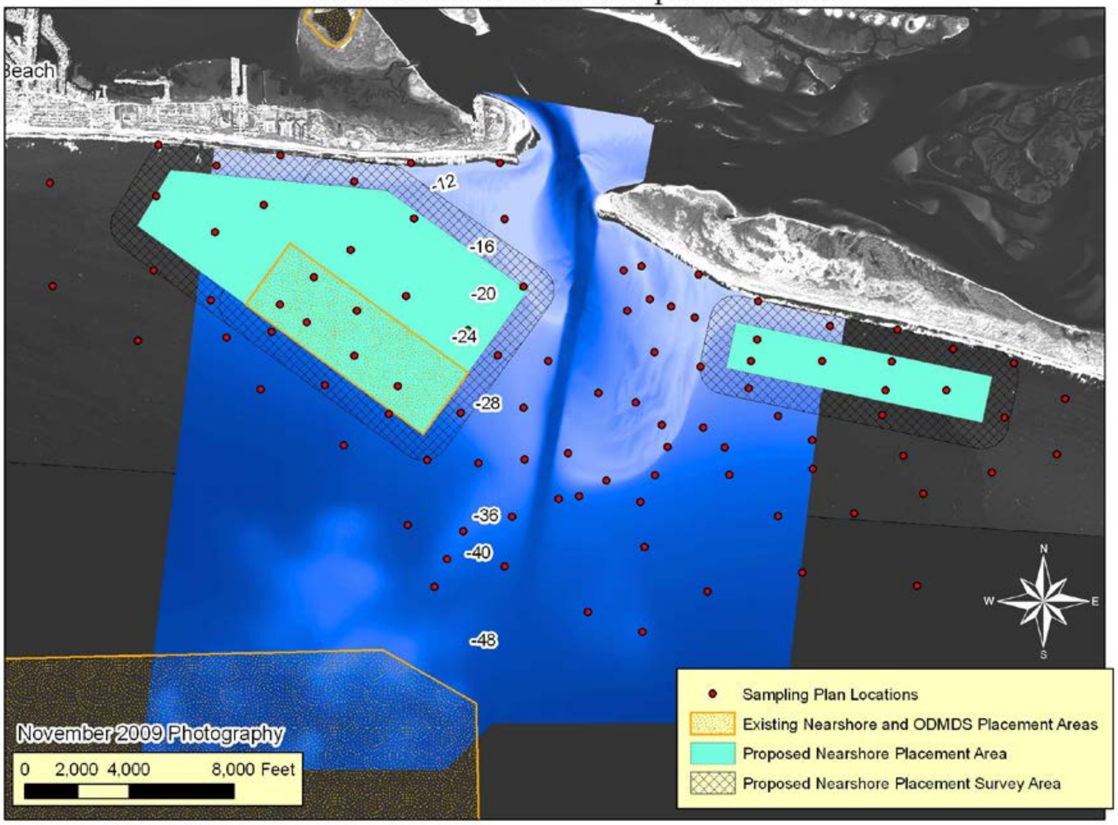

Figure 5. Beaufort Inlet Grab Sample Locations

References

Buttolph, A.M., C.W. Reed, N.C. Kraus, N. Ono, M. Larson, B. Camenen, H. Hanson, T. Wamsley, and A.K. Zundel. (2006). “Two-dimensional depth-averaged circulation model CMS-M2D: Version 3.0, Report 2: Sediment transport and morphology change.” Coastal and Hydraulics Laboratory Technical Report ERDC/CHL TR-06-09. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

Luettich, R.A., Westerink, J.J., and Scheffner, N.W. (1991). “ADCIRC: An Advanced Three-dimensional Circulation Model for Shelves, Coasts, and Estuaries; Report 1: Theory and Methodology of ADCIRC-2DDI and 3DL. TR DRP-92-6.” USAE Waterways Experiment Station, Vicksburg, MS.

USACE (2009). “Morehead City Ocean Dredged Material Disposal Site; Site Management and Monitoring Plan” U.S. Army Corps of Engineers, Wilmington District. April 2009.

APPENDIX G

COST ESTIMATES
MOREHEAD CITY HARBOR DMMP

Appendix G: Cost Engineering

Morehead City Harbor DMMP
Morehead City
NORTH CAROLINA

1. The Cost Engineering Appendix project costs were prepared to identify the Current Working Estimate (CWE) for the least cost, environmentally acceptable alternative for disposal of maintenance dredged material from Morehead City Harbor for 20 years.

Costs for the alternative selected plan are shown in ATTACHMENT 1. The plan occurs over a 3-year period and then is repeated each 3 year period with possibly some minor variances depending on dredging quantities. Attachment 1 (sheet 1) (for years 2015-2028 Inner harbor disposal to Brandt Island) and Attachment 1 (sheet 2) (years 2029-2034 Inner Harbor disposal to ODMDS) shows unit price, quantity, mob/demob, contract durations, and total cost with a 20% contingency.

2. The TOTAL CURRENT WORKING ESTIMATE (CWE) for the 3 year cycle as shown in Attachment 1 (sheet 1) - $33,684,000 and Attachment 1 (sheet 2) - $35,354,000. These construction, monitoring, engineering and construction management costs have been established to be the Baseline CWE at January 2011 price levels.

The CWE's are shown in the MCACES (Microcomputer Aided Cost Engineering System) summary sheets – Attachment 2. MCACES is the format used to identify costs within Corps of Engineers report documents.

3. The Cost Estimates were prepared under guidance given in the Corps of Engineers Regulation ER 1110-2-1302, CIVIL WORKS COST ENGINEERING and Engineering Instructions, ETL 1110-2-573, CONSTRUCTION COST ESTIMATES.

4. Details of the viable DMMP alternatives considered are identified in Section 3 of the DMMP Main Report. Unit costs for a multitude of dredging alternatives for each reach of the Morehead City Harbor are shown in Attachment 3. The Harbor was divided into 5 reaches or sections from the Inner Harbor through the outer Ocean Bar. Disposal or placement locations for each reach and various methods

of dredging are also identified in Attachment 3. The reaches represent similar material characteristics within each reach.

The 5 separate reaches/sections were identified as follows:

1. Northwest Leg, West Leg(1) and East Leg – typically less than 80% sand
2. West Leg(2) and N. Range C – typically material between 80% and 90% sand
3. South Range C and N. Range B – material greater than 90% sand
4. South Range B, Cutoff channel thru N. Range A to Station 110+00
   – material greater than 90% sand
5. South Range A Station 110+00 thru 125+00 – typically less than 80% sand

Attachment 3 shows viable dredging alternative methods and disposal or placement locations considered. Only unit prices are shown along with yearly contract quantities of material likely to be dredged. Unit prices are not shown for alternatives which were determined not to be a reasonable solution because of environmental restrictions, soil characteristics, equipment limitations, etc. Attachment 3 was used as a first step for identifying unit prices to be carried forward into Attachment 4 which includes MOB & DEMOB and average annual costs.

5. Unit prices and mobilization-demobilization costs were developed for all alternatives using CEDEP (Corps of Engineers Dredge Estimating Program) and review of historical methods and pricing where conditions were similar.

6. Dredging quantities were developed by Coastal Engineering Section and are annual contract quantities of material likely to be dredged. Year 2 and Year 3 are multiples of the annual quantities.

7. Attachment 4 combines unit prices, quantities, and mob/demob with dredging methods for each alternative evaluated. A contingency of 20% was included to represent unanticipated conditions or uncertainties at the time the estimate was developed.

8. Based on typical needs and past dredging patterns/methods, a description of the alternative SELECTED PLAN as shown in Attachment 1is as follows:

YEAR 1- Pipeline dredge material from Reach 4 (1,200,000 cy), to the beach on Bogue Banks and Shackleford Banks. Material dredged is from the reach S. Range B, Cutoff channel, and thru N. Range A (Station 110+00).

YEAR 2- Hopper dredge from Reach 3 (346,000 cy) and Reach 4 (650,000 cy) to Nearshore placement areas in the ebb tide delta region of Bogue and Shackleford Banks.

YEAR 3 – Pipeline dredge material from Reach 1 (362,000 cy) from Northwest Leg, East Leg, and West Leg(1) and pipeline dredge Reach 2 (152,000 cy) West Leg(2) and N. Range C into Brandt Island. (In years 2029-2034 dredging will be by Bucket and Barge to the ODMDS because Brandt Island will have reached capacity and cannot accept any more dredge material).

- In addition to pipeline dredge in YEAR 3, a Hopper will dredge material Reach 4 (810,000 cy) to the Nearshore placement areas in the ebb tide delta region of Bogue and Shackleford Banks. Reach 5 will also Hopper dredge material (344,000 CY) in S. Range A (from Station 110+00 to 125+00) to the ODMDS.

Most of the Mob & Demob costs represent combining MHC Harbor dredging activities with other contracts using similar equipment, except when material in Reach 4 is placed on the beaches at Bogue and Shackleford Banks.

Construction/dredging times are shown in months with each alternative shown in Attachment 1. All construction times can be completed within required environmental windows where applicable.

9. Other alternatives associated within the DMMP and dredging scenarios included evaluation of dike raises at Brandt Island, clean out of Brandt Island for additional capacity and potential construction of bird islands. These associated costs are shown in Attachment 5. These costs are not part of the selected plan for 15 years.

The preliminary evaluation of the latter years, 15 thru 20, indicates it would become more beneficial to dredge material in Reaches 1 and 2 and haul material to the ODMDS, rather than building dikes and continuing pipeline dredging material into Brandt Island. This comparable scenario will continue to be reviewed and updated throughout the DMMP project life.

Attachment 1 (sheet 1) - MOREHEAD CITY HARBOR DMMP - - PROPOSED PLAN - - RECURRING PLAN EVERY THREE (3) YEARS for Years 2015-2028 — **JANUARY 1, 2011 PRICE LEVEL**

	Dredging Location	Dredging Method	Disposal or Placement Location	PIPE DISTANCE	MILES	YEAR 1 Unit price / QTY / Contract Time	YEAR 2 Unit price / QTY / Contract Time	YEAR 3 Unit price / QTY / Contract Time
IH-1	**Northwest & West Leg(1) and East Leg**	Small Pipeline dredge	Brandt Island	6,000 LF				**362,000 cy** 1.7 Mos Part 1 of 2 Reaches for Year 3 Contract **$4.35** Mob-As part of larger waterway contract Mob-Demob TOTAL = $1,574,700 + $200,000 =$1,774,700 **Pipeline Dredge** with 20% Contingency = **$2,129,640**
IH-12	**West Leg(2) & N.Range C**	Small Pipeline dredge	Brandt Island	6,000 LF				**152,000 cy** 0.7 Mos Part 2 of 2 Reaches for Year 3 Contract Mob-As part of larger waterway contract % Mob-Demob TOTAL **$4.30** = $653,600 + $200,000 =$853,600 **Pipeline Dredge** with 20% Contingency = **$1,024,320**
OH-5	**S.Range C & N.Range B**	Hopper Dredge	Nearshore East		6.7 MILES		**346,000 cy** 0.8 Mos **Hopper Dredge** Part 1 of 2 Reaches for Year 2 Contract % Mob-Demob TOTAL **$4.25** = $1,470,500 + $275,000 =$1,745,500 with 20% Contingency = **$2,094,600**	
OH-7a	**S.Range C & N.Range B**	Hopper Dredge	Nearshore West		6.7 MILES			
	Quantity to nearshore- split 78% and 22%		269,880 cy WEST	76,120 cy EAST				
OH-16 & OH-18a	**S.Range B, Cut-off, N.Range A to Sta 110**	Hopper	Nearshore West & East		5.2 MILES	**1,200,000 cy** 2.6 Mos Mob-Demob TOTAL **$7.82** = $9,384,000 + $3,100,000 =$12,484,000 **Pipeline Dredge w/placement on the beaches** with 20% Contingency = **$14,980,800** Added mob both beaches w/conting **$600,000**	**650,000 cy** 1.4 Mos **Hopper Dredge** Part 2 of 2 Reaches for Year 2 Contract % Mob-Demob TOTAL **$4.10** = $2,665,000 + $275,000 =$2,940,000 with 20% Contingency = **$3,528,000**	**810,000 cy** 1.8 Mos **Hopper Dredge** Part 1 of 2 Reaches for same Hopper contract % Mob-Demob TOTAL **$4.10** = $3,321,000 + $275,000 =$3,596,000 with 20% Contingency = **$4,315,200**
	Quantity to nearshore- split 78% and 22% Yr. 2		507,000 cy WEST	143,000 cy EAST				
	Yr. 3		631,800 cy WEST	178,200 cy EAST				
OH-19	**S.Range B, Cut-off, N.Range A to Sta 110**	Large Pipeline dredge	Bogue Banks	18,500 LF	Avg unit price			
	Quantity to beaches -split 57% and 43%		684,000 cy Bogue	516,000 cy Shackleford				
OH-21	**S.Range B, Cut-off, N.Range A to Sta 110**	Large Pipeline dredge	Shackleford Banks	19,500 LF	**$7.85 /cy**			
	Additional	$500,000	Mob-Demob pipe & equipment (both beaches)					
OEC-3	**S.Range A, Sta 110+00 to 125+00**	Hopper	ODMDS		5.0 MILES			**344,000 cy** 0.8 Mos **Hopper Dredge** Part 2 of 2 Reaches for same Hopper contract % Mob-Demob TOTAL **$3.50** = $1,204,000 + $275,000 =$1,479,000 with 20% Contingency = **$1,774,800**
		Total Quantities		3,864,000 cy		2.6 Mos YEAR 1 **1,200,000 cy**	2.2 Mos YEAR 2 **996,000 cy**	5.0 Mos YEAR 3 **1,668,000 cy**
		TOTAL Dredging all 3 years without contingency		**$25,372,800**		**TOTAL YEAR 1 with Contingency** **$15,580,800** Dredging Only	**TOTAL YEAR 2 with Contingency** **$5,622,600** Dredging Only	**TOTAL YEAR 3 with Contingency** **$9,243,960** Dredging Only
		TOTAL Dredging all 3 years with Contingency		**$30,447,360**				
	Monitoring w/contingency					**MONITORING w/conting** **$542,570**	**MONITORING w/conting** **$510,600**	**MONITORING w/conting** **$498,295**
	PED 3%					**PED w/conting** **$467,424**	**PED w/conting** **$168,678**	**PED w/conting** **$277,319**
	S&A # mos * $65,000					**S&A w/conting** **$205,196**	**S&A w/conting** **$172,640**	**S&A w/conting** **$393,708**
	TOTAL YEARLY					**TOTAL YEARLY w/20% contingency** **$16,795,990**	**TOTAL YEARLY w/20% contingency** **$6,474,518**	**TOTAL YEARLY w/20% contingency** **$10,413,282**
						WITHOUT CONTINGENCY **$13,996,658**	WITHOUT CONTINGENCY **$5,395,432**	WITHOUT CONTINGENCY **$8,677,735**

Attachment 1 (sheet 1 of 2) – Costs for Proposed Base Plan - Years 2015 through 2028

Attachment 1 (sheet 2) - MOREHEAD CITY HARBOR DMMP - - PROPOSED PLAN - - RECURRING PLAN EVERY THREE (3) YEARS for **Years 2029- 2034** | JANUARY 1, 2011 PRICE LEVEL

Attachments 1a and 1b identify the proposed plan for each year of the 3-year maintenance cycle

	Dredging Location	Dredging Method	Disposal or Placement Location	PIPE DISTANCE	MILES	YEAR 1 Unit price / QTY / Contract Time	YEAR 2 Unit price / QTY / Contract Time	YEAR 3 Unit price / QTY / Contract Time
IH-2	**Northwest & West Leg(1) and East Leg**	Bucket & Barge	ODMDS		10.1 MILES			**362,000 cy** 1.3 Mos Part 1 of 2 Reaches for Year 3 Contract **$7.07** Mob-As part of larger waterway contract = $2,559,340 Mob-Demob + $185,000 TOTAL =$2,744,340 Bucket & Barge with 20% Contingency = **$3,293,208**
IH-13	**West Leg(2) & N.Range C**	Bucket & Barge	ODMDS		9.6 MILES			**152,000 cy** 0.6 Mos Part 2 of 2 Reaches for Year 3 Contract Mob-As part of larger waterway contract **$7.15** = $1,086,800 % Mob-Demob + $185,000 TOTAL =$1,271,800 Bucket & Barge with 20% Contingency = **$1,526,160**
OH-5	**S.Range C & N.Range B**	Hopper Dredge	Nearshore East		6.7 MILES		**346,000 cy** 0.8 Mos **Hopper Dredge** Part 1 of 2 Reaches for Year 2 Contract **$4.25** = $1,470,500 % Mob-Demob + $275,000 TOTAL =$1,745,500 with 20% Contingency = **$2,094,600**	
OH-7a	**S.Range C & N.Range B**	Hopper Dredge	Nearshore West		6.7 MILES			
	Quantity to nearshore - split 78% and 22%		269,880 cy WEST	76,120 cy EAST				
OH-16 & OH-18a	**S.Range B, Cut-off, N.Range A to Sta 110**	Hopper	Nearshore West & East		5.2 MILES	**1,200,000 cy** 2.6 Mos	**650,000 cy** 1.4 Mos **Hopper Dredge** Part 2 of 2 Reaches for Year 2 Contract **$4.10** = $2,665,000 % Mob-Demob + $275,000 TOTAL =$2,940,000 Hopper with 20% Contingency = **$3,528,000**	**810,000 cy** 1.8 Mos **Hopper Dredge** Part 1 of 2 Reaches for same Hopper contract **$4.10** = $3,321,000 % Mob-Demob + $275,000 TOTAL =$3,596,000 Hopper with 20% Contingency = **$4,315,200**
	Quantity to nearshore -split 78% and 22% Yr. 2		507,000 cy WEST	143,000 cy EAST				
	Yr. 3		631,800 cy WEST	178,200 cy EAST				
OH-19	**S.Range B, Cut-off, N.Range A to Sta 110**	Large Pipeline dredge	Bogue Banks	18,500 LF	Avg unit price	**$7.82** = $9,384,000 Mob-Demob + $3,100,000 TOTAL =$12,484,000		
	Quantity to beaches - split 57% and 43%		684,000 cy Bogue	516,000 cy Shackleford		**Pipeline placement on the beaches**		
OH-21	**S.Range B, Cut-off, N.Range A to Sta 110**	Large Pipeline dredge	Shackleford Banks	19,500 LF	**$7.85 /cy**	with 20% Contingency = **$14,980,800**		
	Additional	$500,000	Mob-Demob pipe & equipment (both beaches)			Added mob both beaches w/conting **$600,000**		
OEC-3	**S.Range A, Sta 110+00 to 125+00**	Hopper	ODMDS		5.0 MILES			**344,000 cy** 0.8 Mos **Hopper Dredge** Part 2 of 2 Reaches for same Hopper contract **$3.50** = $1,204,000 % Mob-Demob + $275,000 TOTAL =$1,479,000 Hopper with 20% Contingency = **$1,774,800**
		TOTAL Quantities		**3,864,000 cy**		2.6 Mos YEAR 1 **1,200,000 cy**	2.2 Mos YEAR 2 **996,000 cy**	4.5 Mos YEAR 3 **1,668,000 cy**
		TOTAL Dredging all 3 years without contingency		**$26,760,640**		**TOTAL YEAR 1 with Contingency** **$15,580,800** Dredging Only	**TOTAL YEAR 2 with Contingency** **$5,622,600** Dredging Only	**TOTAL YEAR 3 with Contingency** **$10,909,368** Dredging Only
		TOTAL Dredging all 3 years with contingency		**$32,112,768**				
	Monitoring w/contingency					**MONITORING w/conting** **$542,570**	**MONITORING w/conting** **$510,600**	**MONITORING w/conting** **$498,295**
	PED 3%					**PED w/conting** **$467,424**	**PED w/conting** **$168,678**	**PED w/conting** **$327,281**
	S&A # mos * $65,000					**S&A w/conting** **$205,196**	**S&A w/conting** **$172,640**	**S&A w/conting** **$348,516**
	TOTAL YEARLY					**TOTAL YEARLY w/20% contingency** **$16,795,990**	**TOTAL YEARLY w/20% contingency** **$6,474,518**	**TOTAL YEARLY w/20% contingency** **$12,083,460**
						WITHOUT CONTINGENCY **$13,996,658**	WITHOUT CONTINGENCY **$5,395,432**	WITHOUT CONTINGENCY **$10,069,550**

Attachment 1 (sheet 2 of 2) – Costs for Proposed Base Plan - Years 2029 through 2034

Attachment 2 – MCACES (7 pages)

Print Date Wed 2 May 2012 Eff. Date 1/1/2011	U.S. Army Corps of Engineers Project : MHC DMMP MAY 1 2012 (2015-2028) MOREHEAD CITY HARBOR - DMMP	Time 17:16:52 Title Page

MHC DMMP MAY 1 2012 (2015-2028)
MOREHEAD CITY DMMP - CURRENT WORKING ESTIMATE (CWE) YEARS 2015 to 2028

Estimated by	CESAW-TS-EE
Designed by	USACE - WILMINGTON DISTRICT
Prepared by	John Caldwell
Preparation Date	4/30/2012
Effective Date of Pricing	1/1/2011
Estimated Construction Time	150 Days

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Labor ID: SAV11 EQ ID: EP09R03 | Currency in US dollars | TRACES MII Version 4.1

Date	Author	Note
	CESAW-TS-EE	See COST NARRATIVE as part of this APPENDIX
10/29/2010	CESAW-TS-EE	This detail estimate is for the MHC DMMP

Description	Quantity	UOM	ContractCost	Contingency	ProjectCost
Project Cost Summary Report			28,106,379	5,577,411	33,683,789
12 MHC DMMP - YEAR 1 --	1	LS	13,996,658	2,799,332	16,795,990
12_02 --Pipeline to Bogue and Shackleford Banks	1	LS	12,984,000	2,596,800	15,580,800
30 --MONITORING	1	LS	452,141	90,428	542,569
30 --PLANNING, ENGINEERING & DESIGN	1	LS	389,520	77,904	467,424
31 --S&A-CONST MGT	1	LS	170,997	34,199	205,196
12 MHC DMMP - YEAR 2 ---	1	LS	5,413,932	1,060,586	6,474,518
12_02 --Hopper Dredge to Nearshore	1	LS	4,685,500	937,100	5,622,600
31 --MONITORING	1	LS	444,000	66,600	510,600
30 --PLANNING, ENGINEERING & DESIGN	1	LS	140,565	28,113	168,678
31 --S&A-CONST MGT	1	LS	143,867	28,773	172,640
12 MHC DMMP - YEAR 3 ---	1	LS	8,695,789	1,717,493	10,413,282
12_02 --Pipeline to Brandt Island	1	LS	2,628,300	525,660	3,153,960
12_03 --Hopper Dredge to Nearshore & ODMDS	1	LS	5,075,000	1,015,000	6,090,000
30 --MONITORING	1	LS	433,300	64,995	498,295
30 --PLANNING, ENGINEERING & DESIGN	1	LS	231,099	46,220	277,319
31 --S&A-CONST MGT	1	LS	328,090	65,618	393,708

Currency in US dollars

Description	Quantity	UOM	ContractCost	Contingency	ProjectCost
Contract Cost Summary Report			28,106,379	5,577,411	33,683,789
12 MHC DMMP - YEAR 1 --	1	LS	13,996,658	2,799,332	16,795,990
12_02 --Pipeline to Bogue and Shackleford Banks	1	LS	12,984,000	2,596,800	15,580,800
---1 PIPELINE - Mob, Demob & Preparatory Work	1	LS	3,600,000	720,000	4,320,000
---2 Dredge South Rg B; Cutoff; and North Rg A to Station 110+00	1,200,000	CY	*7.82* 9,384,000	1,876,800	*9.38* 11,260,800
30 --MONITORING	1	LS	452,141	90,428	542,569
30_23 --MONITORING	1	LS	452,141	90,428	542,569
30 --PLANNING, ENGINEERING & DESIGN	1	LS	389,520	77,904	467,424
30_23 --Plans, Engineering and Design	1	LS	389,520	77,904	467,424
31 --S&A-CONST MGT	1	LS	170,997	34,199	205,196
31_12 --Construction Mgt	1	LS	170,997	34,199	205,196
12 MHC DMMP - YEAR 2 ---	1	LS	5,413,932	1,060,586	6,474,518
12_02 --Hopper Dredge to Nearshore	1	LS	4,685,500	937,100	5,622,600
--1 Mob, Demob & Preparatory Work	1	LS	550,000	110,000	660,000
--2 Dredge South Range "C" & N. Range "B" to Nearshore	346,000	CY	*4.25* 1,470,500	294,100	*5.10* 1,764,600
--3 Dredge South Range "B", CUTOFF, & N. Range "A" TO STA. 110+00 to Nearshore	650,000	CY	*4.10* 2,665,000	533,000	*4.92* 3,198,000
31 --MONITORING	1	LS	444,000	66,600	510,600
30_23 --MONITORING	1	LS	444,000	66,600	510,600
30 --PLANNING, ENGINEERING & DESIGN	1	LS	140,565	28,113	168,678
30_23 --Plans, Engineering and Design	1	LS	140,565	28,113	168,678
31 --S&A-CONST MGT	1	LS	143,867	28,773	172,640
31_12 --Construction Contracts	1	LS	143,867	28,773	172,640
12 MHC DMMP - YEAR 3 --	1	LS	8,695,789	1,717,493	10,413,282
12_02 --Pipeline to Brandt Island	1	LS	2,628,300	525,660	3,153,960
---1 PIPELINE - Mob, Demob & Preparatory Work	1	LS	400,000	80,000	480,000

Currency in US dollars

Description	Quantity	UOM	ContractCost	Contingency	ProjectCost
			4.35		5.22
---2 Dredge Northwest; &WEST LEG (1) & East Leg to Brandt Island	362,000	CY	1,574,700	314,940	1,889,640
			4.30		5.16
---3 Dredge WEST LEG (2) and N. Range "C" to Brandt Island	152,000	CY	653,600	130,720	784,320
12_03 --Hopper Dredge to Nearshore & ODMDS	1	LS	5,075,000	1,015,000	6,090,000
---1 HOPPER - Mob, Demob & Preparatory Work	1	LS	550,000	110,000	660,000
			4.10		4.92
---2 Dredge South Range "B",- CUTOFF, & -N. Range "A" TO STA. 110+00 to NEARSHORE	810,000	CY	3,321,000	664,200	3,985,200
			3.50		4.20
---2 Dredge South Range "A" - - Sta 110+00 to 125+00 to ODMDS	344,000	CY	1,204,000	240,800	1,444,800
30 --MONITORING	1	LS	433,300	64,995	498,295
30_23 --MONITORING	1	LS	433,300	64,995	498,295
30 --PLANNING, ENGINEERING & DESIGN	1	LS	231,099	46,220	277,319
30_23 --Plans, Engineering and Design	1	LS	231,099	46,220	277,319
31 --S&A-CONST MGT	1	LS	328,090	65,618	393,708
31_12 --Construction Mgt	1	LS	328,090	65,618	393,708

Currency in US dollars

Attachment 3 (sheet 1 of 2) - Morehead City Harbor DMMP - Cost Estimates (Short Version)

Dredging methods & disposal locations considered for each reach of the project. Only unit prices are shown along with yearly anticipated shoaling rates for years 1, 2, and 3.
Unit Prices are **not** shown for measures determined not to be reasonable options because of environmental restrictions due to soil characteristics, equipment limitations, etc.
This sheet was used to identify costs to carry forward into the more detailed analysis in Attachment 4, which includes Mob and Demob.
Bold lettering identifies the selected measures after analysis of all measures. Background colors represent various types of dredges.

Item ID #	Effective Pricing Level is January 2011 ---------- Morehead City Harbor DMMP Reaches	Dredging Method	Disposal or Placement Location	Pipeline Distance (Linear Feet)	1-way travel Distance	1-YR QTY		2-YR QTY		3-YR QTY
						120,750 cy		**241,500 cy**		**362,250 cy**
IH-1	IH (NW-W(1)-EAST)	18-inch Pipeline	Brandt Island	6,000 LF		$4.96		$4.47		**$4.34**
IH-2	IH (NW-W(1)-EAST)	Mechanical w/ Scow	ODMDS		10.1 miles	$7.13		$7.09		$7.07
						50,750 cy		**101,500 cy**		**152,250 cy**
IH-12	IH (W2-N.Range C)	18-inch Pipeline	Brandt Island	6,000 LF		$6.08		$4.64		**$4.30**
IH-13	IH (W2-N.Range C)	Mechanical w/ Scow	ODMDS		9.6 miles	$7.79		$7.29		$7.15
IH-14	IH (W2-N.Range C)	Hopper	ODMDS		9.6 miles	$7.61		$7.28		$7.24
IH-15	IH (W2-N.Range C)	Mechanical w/ Scow	Nearshore West-shallow		7.5 miles	$8.29		$7.49		$7.41
IH-15a	IH (W2-N.Range C)	Mechanical w/ Scow	Nearshore West- expanded		8.0 miles	$7.67		$7.39		$7.06
IH-15b	IH (W2-N.Range C)	Mechanical w/ Scow	Nearshore West- existing		7.0 miles	$7.62		$7.31		$7.01
IH-16	IH (W2-N.Range C)	Hopper	Nearshore West -shallow		7.5 miles	$8.69		$8.47		$8.39
IH-16a	IH (W2-N.Range C)	Hopper	Nearshore West -expanded		8.0 miles	$7.61		$7.50		$7.32
IH-16b	IH (W2-N.Range C)	Hopper	Nearshore West -existing		7.0 miles	$7.18		$6.96		$6.74
IH-17	IH (W2-N.Range C)	Mechanical w/ Scow	Nearshore East- shallow		7.5 miles	$8.29		$7.49		$7.41
IH-17a	IH (W2-N.Range C)	Mechanical w/ Scow	Nearshore East		7.0 miles	$7.62		$7.31		$7.01
IH-18	IH (W2-N.Range C)	Hopper	Nearshore East - shallow		7.5 miles	$8.69		$8.47		$8.39
IH-18a	IH (W2-N.Range C)	Hopper	Nearshore East		7.0 miles	$7.18		$6.96		$6.74
						115,450 cy		**230,900 cy**		**346,350 cy**
OH-1	OH (S.Range C-N.Range B)	18-inch Pipeline	Brandt Island	6,000 LF			NOT VIABLE- Material is greater than 90 % SAND			
OH-2	OH (S.Range C-N.Range B)	Mechanical w/ Scow	ODMDS		9.4 miles	$7.62		$7.27		$7.10
OH-3	OH (S.Range C-N.Range B)	Hopper	ODMDS		9.4 miles	$4.87		$4.54		$4.44
OH-4	OH (S.Range C-N.Range B)	Mechanical w/ Scow	Nearshore West-Existing		6.7 miles	$7.28		$7.15		$6.96
OH-4a	OH (S.Range C-N.Range B)	Mechanical w/ Scow	Nearshore West-expanded		7.7 miles	$7.54		$7.33		$7.01
OH-4b	OH (S.Range C-N.Range B)	Mechanical w/ Scow	Nearshore West-shallow		7.2 miles	$8.28		$7.49		$7.34
OH-5	OH (S.Range C-N.Range B)	Hopper	Nearshore West-existing		6.7 miles	$4.67		$4.35		**$4.23**
OH-5a	OH (S.Range C-N.Range B)	Hopper	Nearshore West-expanded		7.7 miles	$5.08		$4.55		$4.52
OH-5b	OH (S.Range C-N.Range B)	Hopper	Nearshore West-shallow		7.2 miles	$5.91		$5.28		$5.14
OH-6	OH (S.Range C-N.Range B)	Mechanical w/ Scow	Nearshore East-shallow		7.2 miles	$8.28		$7.49		$7.34
OH-6a	OH (S.Range C-N.Range B)	Mechanical w/ Scow	Nearshore East		6.7 miles	$7.28		$7.15		$6.96
OH-7	OH (S.Range C-N.Range B)	Hopper	Nearshore East-shallow		7.2 miles	$5.91		$5.28		$5.14
OH-7a	OH (S.Range C-N.Range B)	Hopper	Nearshore East		6.7 miles	$4.67		$4.35		**$4.23**
OH-8	OH (S.Range C-N.Range B)	18-inch Pipeline	Fort Macon & Atlantic Beach	17,800 LF	3.4 miles	$10.39		$8.20		$8.20
OH-9	OH (S.Range C-N.Range B)	30-inch Pipeline	Fort Macon & Atlantic Beach	17,800 LF	3.4 miles	$8.85	$8.00 AVG	$7.14		$6.50
OH-9a	OH (S.Range C-N.Range B)	30-inch Pipeline	Nearshore - West	27,500 LF	5.2 miles	$10.81		$9.17		$8.80
OH-10	OH (S.Range C-N.Range B)	18-inch Pipeline	Shackleford Banks Beach	21,000 LF	4.0 miles	$12.28		$9.79		$9.30
OH-11	OH (S.Range C-N.Range B)	30-inch Pipeline	Shackleford Banks Beach	21,000 LF	4.0 miles	$9.70	$8.80 AVG	$7.89		$7.05
OH-11a	OH (S.Range C-N.Range B)	30-inch Pipeline	Nearshore - East	27,500 LF	5.2 miles	$10.81		$9.17		$8.80
OH-11b	OH (S.Range C-N.Range B)	18-inch Pipeline	Nearshore - East/West	27,500 LF	5.2 miles	$11.94		$11.34		$11.14
						886,050 cy		**1,772,100 cy**		**2,658,150 cy**
OH-12	OH (S.Range B, Cut-off, N.Range A; thru 110)	18-inch Pipeline	Brandt Island	13,000 LF			NOT VIABLE- Material is greater than 90 % SAND			
OH-13	OH (S.Range B, Cut-off, N.Range A; thru 110)	Mechanical w/ Scow	ODMDS		7.7 miles	$7.56		$7.13		$6.94
OH-14	OH (S.Range B, Cut-off, N.Range A; thru 110)	Hopper	ODMDS		7.7 miles	$4.24		$4.02		$3.98
OH-15	OH (S.Range B, Cut-off, N.Range A; thru 110)	Mechanical w/ Scow	Nearshore West-Existing		5.2 miles	$7.24		$7.01		$6.91
OH-15a	OH (S.Range B, Cut-off, N.Range A; thru 110)	Mechanical w/ Scow	Nearshore West-expanded		6.1 miles	$7.47		$7.13		$6.95
OH-15b	OH (S.Range B, Cut-off, N.Range A; thru 110)	Mechanical w/ Scow	Nearshore West-shallow		5.7 miles	$8.20		$7.45		$7.18
OH-16	OH (S.Range B, Cut-off, N.Range A; thru 110)	Hopper	Nearshore West-existing		5.2 miles	**$4.06**		$3.86		$3.80
OH-16a	OH (S.Range B, Cut-off, N.Range A; thru 110)	Hopper	Nearshore West-expanded		6.1 miles	$4.34		$4.10		$4.05
OH-16b	OH (S.Range B, Cut-off, N.Range A; thru 110)	Hopper	Nearshore West-shallow		5.7 miles	$4.87		$4.61		$4.54
OH-17	OH (S.Range B, Cut-off, N.Range A; thru 110)	Mechanical w/ Scow	Nearshore East-shallow		5.7 miles	$8.20		$7.45		$7.18
OH-17a	OH (S.Range B, Cut-off, N.Range A; thru 110)	Mechanical w/ Scow	Nearshore East		5.2 miles	$7.24		$7.01		$6.91
OH-18	OH (S.Range B, Cut-off, N.Range A; thru 110)	Hopper	Nearshore East-shallow		5.7 miles	$4.87		$4.61		$4.54
OH-18a	OH (S.Range B, Cut-off, N.Range A; thru 110)	Hopper	Nearshore East		5.2 miles	**$4.06**		$3.86		$3.80
OH-19	OH (S.Range B, Cut-off, N.Range A; thru 110)	30-inch Pipeline	Fort Macon & Atlantic Beach	18,500 LF	3.5 miles	$8.73	**$7.82 AVG**	$6.90	$6.90 AVG	$6.89
OH-19a	OH (S.Range B, Cut-off, N.Range A; thru 110)	30-inch Pipeline	Nearshore - West	24,000 LF	4.5 miles	$9.61	$8.75 AVG	$7.89	$7.72 AVG	$7.54
OH-20	OH (S.Range B, Cut-off, N.Range A; thru 110)	Hopper Pumpout to Beach	Fort Macon & Atlantic Beach		6.5 miles	$10.16		$10.00		$10.00
OH-21	OH (S.Range B, Cut-off, N.Range A; thru 110)	30-inch Pipeline	Shackleford Banks Beach	19,500 LF	3.7 miles	$8.73	**$7.82 AVG**	$6.90	$6.90 AVG	$6.89
OH-21a	OH (S.Range B, Cut-off, N.Range A; thru 110)	30-inch Pipeline	Nearshore - East	24,000 LF	4.5 miles	$9.61	$8.75 AVG	$7.89	$7.72 AVG	$7.54
OH-22	OH (S.Range B, Cut-off, N.Range A; thru 110)	Hopper Pumpout to Beach	Shackleford Banks Beach		6.5 miles	$10.16		$10.00		$10.00
						114,500 cy		**229,000 cy**		**343,500 cy**
OEC-1	OEC (S.Range A; 110 to deep)	18-inch Pipeline	Brandt Island				NOT VIABLE - inefficient equipment operation			
OEC-2	OEC (S.Range A; 110 to deep)	Mechanical w/ Scow	ODMDS		5.0 miles	$7.41		$7.02		$6.36
OEC-3	OEC (S.Range A; 110 to deep)	Hopper	ODMDS		5.0 miles	$3.61		$3.50		**$3.50**

Attachment 3 (sheet 1 of 2) – Morehead City Harbor DMMP Cost Estimates (Short Version)

Attachment 3 (sheet 2 of 2) - Morehead City Harbor DMMP - Cost Estimates (Full Version)

Dredging methods & disposal locations considered for each reach of the project. Only unit prices are shown along with yearly anticipated shoaling rates for years 1, 2, and 3.
Unit Prices are **not** shown for measures determined not to be reasonable options because of environmental restrictions due to soil characteristics, equipment limitations, etc.
This sheet was used to identify costs to carry forward into the more detailed analysis in Attachment 4, which includes Mob and Demob.
Bold lettering identifies the selected measures after analysis of all measures. Background colors represent various types of dredges.

Item ID #	Effective Pricing Level is January 2011 ---------- Morehead City Harbor DMMP Reaches	Dredging Method	Disposal or Placement Location	Pipeline Distance (Linear Feet)	1- Way travel Distance	QTY		QTY		QTY
						120,750 cy		**241,500 cy**		**362,250 cy**
IH-1	IH (NW-W(1)-East)	18-inch Pipeline	Brandt Island	6,000 LF		$4.96		$4.47		**$4.34**
IH-2	IH (NW-W(1)-East)	Mechanical w/ Scow	ODMDS		10.1 miles	$7.13		$7.09		$7.07
IH-3	IH (NW-W(1)-East)	Hopper	ODMDS		10.1 miles	Not a viable alternative equipment efficiency operation				
IH-4	IH (NW-W(1)-East)	Mechanical w/ Scow	Nearshore West		7.5 miles	Not a viable alternative too much fine material				
IH-5	IH (NW-W(1)-East)	Hopper	Nearshore West		7.5 miles	Not a viable alternative too much fine material				
IH-6	IH (NW-W(1)-East)	Mechanical w/ Scow	Nearshore East		7.5 miles	Not a viable alternative too much fine material				
IH-7	IH (NW-W(1)-East)	Hopper	Nearshore East		7.5 miles	Not a viable alternative too much fine material				
IH-8	IH (NW-W(1)-East)	18-inch Pipeline	Fort Macon & Atlantic Beach	23,232 LF	4.4 miles	Not a viable alternative too much fine material				
IH-9	IH (NW-W(1)-East)	30-inch Pipeline	Fort Macon & Atlantic Beach	23,232 LF	4.4 miles	Not a viable alternative too much fine material				
IH-10	IH (NW-W(1)-East)	18-inch Pipeline	Shackleford Banks Beach	25,080 LF	4.8 miles	Not a viable alternative too much fine material				
IH-11	IH (NW-W(1)-East)	30-inch Pipeline	Shackleford Banks Beach	25,080 LF	4.8 miles	Not a viable alternative too much fine material				
						50,750 cy		**101,500 cy**		**152,250 cy**
IH-12	IH (W2-N.Range C)	18-inch Pipeline	Brandt Island	6,000 LF		$6.08		$4.64		**$4.30**
IH-13	IH (W2-N.Range C)	Mechanical w/ Scow	ODMDS		9.6 miles	$7.79		$7.29		$7.15
IH-14	IH (W2-N.Range C)	Hopper	ODMDS		9.6 miles	$7.61		$7.28		$7.24
IH-15	IH (W2-N.Range C)	Mechanical w/ Scow	Nearshore West-shallow		7.5 miles	$8.29		$7.49		$7.41
IH-15a	IH (W2-N.Range C)	Mechanical w/ Scow	Nearshore West- expanded		8.0 miles	$7.67		$7.39		$7.06
IH-15b	IH (W2-N.Range C)	Mechanical w/ Scow	Nearshore West- existing		7.0 miles	$7.62		$7.31		$7.01
IH-16	IH (W2-N.Range C)	Hopper	Nearshore West -shallow		7.5 miles	$8.69		$8.47		$8.39
IH-16a	IH (W2-N.Range C)	Hopper	Nearshore West -expanded		8.0 miles	$7.61		$7.50		$7.32
IH-16b	IH (W2-N.Range C)	Hopper	Nearshore West -existing		7.0 miles	$7.18		$6.96		**$6.74**
IH-17	IH (W2-N.Range C)	Mechanical w/ Scow	Nearshore East- shallow		7.5 miles	$8.29		$7.49		$7.41
IH-17a	IH (W2-N.Range C)	Mechanical w/ Scow	Nearshore East		7.0 miles	$7.62		$7.31		$7.01
IH-18	IH (W2-N.Range C)	Hopper	Nearshore East - shallow		7.5 miles	$8.69		$8.47		$8.39
IH-18a	IH (W2-N.Range C)	Hopper	Nearshore East		7.0 miles	$7.18		$6.96		**$6.74**
IH-19	IH (W2-N.Range C)	18-inch Pipeline	Fort Macon & Atlantic Beach	19,008 LF	3.6 miles	Not a viable alternative - too much fine material				
IH-20	IH (W2-N.Range C)	30-inch Pipeline	Fort Macon & Atlantic Beach	19,008 LF	3.6 miles	Not a viable alternative - too much fine material				
IH-21	IH (W2-N.Range C)	18-inch Pipeline	Shackleford Banks Beach	22,704 LF	4.3 miles	Not a viable alternative - too much fine material				
IH-22	IH (W2-N.Range C)	30-inch Pipeline	Shackleford Banks Beach	22,704 LF	4.3 miles	Not a viable alternative - too much fine material				
IH-23	IH (W2-N.Range C)	30-inch Pipeline	Nearshore West	30,000 LF	5.7 miles	$10.93		$9.78		$9.40
IH-24	IH (W2-N.Range C)	30-inch Pipeline	Nearshore East	30,000 LF	5.7 miles	$10.93		$9.78		$9.40
IH-25	IH (W2-N.Range C)	18-inch Pipeline	Nearshore West/East	30,000 LF	5.7 miles	$12.84		$12.31		$11.45
						115,450 cy		**230,900 cy**		**346,350 cy**
OH-1	OH (S.Range C-N.Range B)	18-inch Pipeline	Brandt Island	6,000 LF			NOT VIABLE- Material is greater than 90 % SAND			
OH-2	OH (S.Range C-N.Range B)	Mechanical w/ Scow	ODMDS		9.4 miles	$7.62		$7.27		$7.10
OH-3	OH (S.Range C-N.Range B)	Hopper	ODMDS		9.4 miles	$4.87		$4.54		$4.44
OH-4	OH (S.Range C-N.Range B)	Mechanical w/ Scow	Nearshore West-Existing		6.7 miles	$7.28		$7.15		**$6.96**
OH-4a	OH (S.Range C-N.Range B)	Mechanical w/ Scow	Nearshore West-expanded		7.7 miles	$7.54		$7.33		$7.01
OH-4b	OH (S.Range C-N.Range B)	Mechanical w/ Scow	Nearshore West-shallow		7.2 miles	$8.28		$7.49		$7.34
OH-5	OH (S.Range C-N.Range B)	Hopper	Nearshore West-existing		6.7 miles	$4.67		$4.35		**$4.23**
OH-5a	OH (S.Range C-N.Range B)	Hopper	Nearshore West-expanded		7.7 miles	$5.08		$4.55		$4.52
OH-5b	OH (S.Range C-N.Range B)	Hopper	Nearshore West-shallow		7.2 miles	$5.91		$5.28		$5.14
OH-6	OH (S.Range C-N.Range B)	Mechanical w/ Scow	Nearshore East-shallow		7.2 miles	$8.28		$7.49		$7.34
OH-6a	OH (S.Range C-N.Range B)	Mechanical w/ Scow	Nearshore East		6.7 miles	$7.28		$7.15		**$6.96**
OH-7	OH (S.Range C-N.Range B)	Hopper	Nearshore East-shallow		7.2 miles	$5.91		$5.28		$5.14
OH-7a	OH (S.Range C-N.Range B)	Hopper	Nearshore East		6.7 miles	$4.67		$4.35		**$4.23**
OH-8	OH (S.Range C-N.Range B)	18-inch Pipeline	Fort Macon & Atlantic Beach	17,800 LF	3.4 miles	$10.39		$8.20		$8.20
OH-9	OH (S.Range C-N.Range B)	30-inch Pipeline	Fort Macon & Atlantic Beach	17,800 LF	3.4 miles	$8.85	$8.00 AVG	$7.14		$6.50
OH-9a	OH (S.Range C-N.Range B)	30-inch Pipeline	Nearshore West	27,500 LF	5.2 miles	$10.81		$9.17		$8.80
OH-10	OH (S.Range C-N.Range B)	18-inch Pipeline	Shackleford Banks Beach	21,000 LF	4.0 miles	$12.28		$9.79		$9.30
OH-11	OH (S.Range C-N.Range B)	30-inch Pipeline	Shackleford Banks Beach	21,000 LF	4.0 miles	$9.70	$8.80 AVG	$7.89		$7.05
OH-11a	OH (S.Range C-N.Range B)	30-inch Pipeline	Nearshore East	27,500 LF	5.2 miles	$10.81		$9.17		$8.80
OH-11b	OH (S.Range C-N.Range B)	18-inch Pipeline	Nearshore West/East	27,500 LF	5.2 miles	$11.94		$11.34		$11.14
						886,050 cy		**1,772,100 cy**		**2,658,150 cy**
OH-12	OH (S.Range B, Cut-off, N.Range A; thru 110)	18-inch Pipeline	Brandt Island	13,000 LF			NOT VIABLE- Material is greater than 90 % SAND			
OH-13	OH (S.Range B, Cut-off, N.Range A; thru 110)	Mechanical w/ Scow	ODMDS		7.7 miles	$7.56		$7.13		$6.94
OH-14	OH (S.Range B, Cut-off, N.Range A; thru 110)	Hopper	ODMDS		7.7 miles	$4.24		$4.02		$3.98
OH-15	OH (S.Range B, Cut-off, N.Range A; thru 110)	Mechanical w/ Scow	Nearshore West-Existing		5.2 miles	$7.24		$7.01		$6.91
OH-15a	OH (S.Range B, Cut-off, N.Range A; thru 110)	Mechanical w/ Scow	Nearshore West-expanded		6.1 miles	$7.47		$7.13		$6.95
OH-15b	OH (S.Range B, Cut-off, N.Range A; thru 110)	Mechanical w/ Scow	Nearshore West-shallow		5.7 miles	$8.20		$7.45		$7.18
OH-16	OH (S.Range B, Cut-off, N.Range A; thru 110)	Hopper	Nearshore West-existing		5.2 miles	**$4.06**		$3.86		$3.80
OH-16a	OH (S.Range B, Cut-off, N.Range A; thru 110)	Hopper	Nearshore West-expanded		6.1 miles	$4.34		$4.10		$4.05
OH-16b	OH (S.Range B, Cut-off, N.Range A; thru 110)	Hopper	Nearshore West-shallow		5.7 miles	$4.87		$4.61		$4.54
OH-17	OH (S.Range B, Cut-off, N.Range A; thru 110)	Mechanical w/ Scow	Nearshore East-shallow		5.7 miles	$8.20		$7.45		$7.18
OH-17a	OH (S.Range B, Cut-off, N.Range A; thru 110)	Mechanical w/ Scow	Nearshore East		5.2 miles	$7.24		$7.01		$6.91
OH-18	OH (S.Range B, Cut-off, N.Range A; thru 110)	Hopper	Nearshore East-shallow		5.7 miles	$4.87		$4.61		$4.54
OH-18a	OH (S.Range B, Cut-off, N.Range A; thru 110)	Hopper	Nearshore East		5.2 miles	**$4.06**		$3.86		$3.80
OH-19	OH (S.Range B, Cut-off, N.Range A; thru 110)	30-inch Pipeline	Fort Macon & Atlantic Beach	18,500 LF	3.5 miles	$8.73	**$7.82 AVG**	$6.90	$6.90 AVG	$6.89
OH-19a	OH (S.Range B, Cut-off, N.Range A; thru 110)	30-inch Pipeline	Nearshore West	24,000 LF	4.5 miles	$9.61	$8.75 AVG	$7.89	$7.72 AVG	$7.54
OH-20	OH (S.Range B, Cut-off, N.Range A; thru 110)	Hopper pumpout to Beach	Fort Macon & Atlantic Beach		6.5 miles	$10.16		$10.00		$10.00
OH-21	OH (S.Range B, Cut-off, N.Range A; thru 110)	30-inch Pipeline	Shackleford Banks Beach	19,500 LF	3.7 miles	$8.73	**$7.82 AVG**	$6.90	$6.90 AVG	$6.89
OH-21a	OH (S.Range B, Cut-off, N.Range A; thru 110)	30-inch Pipeline	Nearshore East	24,000 LF	4.5 miles	$9.61	$8.75 AVG	$7.89	$7.72 AVG	$7.54
OH-22	OH (S.Range B, Cut-off, N.Range A; thru 110)	Hopper Pumpout to Beach	Shackleford Banks Beach		6.5 miles	$10.16		$10.00		$10.00
						114,500 cy		**229,000 cy**		**343,500 cy**
OEC-1	OEC (S.Range A; 110 to deep)	18-inch Pipeline	Brandt Island			Not a viable alternative equipment efficiency operation				
OEC-2	OEC (S.Range A; 110 to deep)	Mechanical w/ Scow	ODMDS		5.0 miles	7.41		7.02		6 LF
OEC-3	OEC (S.Range A; 110 to deep)	Hopper	ODMDS		5.0 miles	$3.61		$3.50		**$3.50**
OEC-4	OEC (S.Range A; 110 to deep)	Mechanical w/ Scow	Nearshore West		2.5 miles	Not a viable alternative - too much fine material				
OEC-5	OEC (S.Range A; 110 to deep)	Hopper	Nearshore West		2.5 miles	Not a viable alternative - too much fine material				
OEC-6	OEC (S.Range A; 110 to deep)	Mechanical w/ Scow	Nearshore East		2.9 miles	Not a viable alternative - too much fine material				
OEC-7	OEC (S.Range A; 110 to deep)	Hopper	Nearshore East		2.9 miles	Not a viable alternative - too much fine material				
OEC-8	OEC (S.Range A; 110 to deep)	18-inch Pipeline	Fort Macon & Atlantic Beach	19,958 LF	3.8 miles	Not a viable alternative - too much fine material				
OEC-9	OEC (S.Range A; 110 to deep)	30-inch Pipeline	Fort Macon & Atlantic Beach	19,958 LF	3.8 miles	Not a viable alternative - too much fine material				
OEC-10	OEC (S.Range A; 110 to deep)	18-inch Pipeline	Shackleford Banks Beach			Not a viable alternative - too much fine material				
OEC-11	OEC (S.Range A; 110 to deep)	30-inch Pipeline	Shackleford Banks Beach			Not a viable alternative - too much fine material				

Attachment 3 (sheet 2 of 2) – Morehead City Harbor DMMP Cost Estimates (Full Version)

Attachment 4 - Morehead City Harbor DMMP Detailed Costs for Viable Measures
Costs shown include quantities, unit prices, mob/demob, contingency, and average cost per dredging cycle for all measures shown in Attachment 3
Fuel Price = $3.00/Gallon

New ID	Range/Dredging Frequency/Disposal Location	Dredging Method			Dredging Quantity CY	Mob & Demob	Unit Price	Dredging Event Cost	with Contingency 26%	Effective Cost/cy	Average Cost Per Cycle
	NORTHWEST LEG, WEST LEG #1, AND EAST LEG										
IH$_1$	Brandt Island -No Overflow	18" Pipeline		16/18 Inch Pipeline							
	Annual				**120,750 cys**	$200,000	$4.96	$598,920	$1,006,639	$8.34	$1,006,639
	2-year Frequency				**241,500 cys**	$200,000	$4.47	$1,079,505	$1,612,176	$6.68	$806,088
	3-year Frequency				**362,250 cys**	$200,000	**$4.34**	$1,572,165	$2,232,928	$6.16	$744,309
	Mob/Demob considered shared with another contract where 18inch required i.e. within Morehead Harbor, AIWW, etc										
IH$_2$	ODMDS - No Overflow	Bucket & Barge	X	2,750 cy/load							
	Annual				**120,750 cys**	$185,000	$7.13	$860,948	$1,317,894	$10.91	$1,317,894
	2-year Frequency				**241,500 cys**	$185,000	$7.09	$1,712,235	$2,390,516	$9.90	$1,195,258
	3-year Frequency				**362,250 cys**	$185,000	$7.07	$2,561,108	$3,460,095	**$9.55**	$1,153,365
	Mob/Demob shared with East Leg and North Range C or other Morehead bucket barge range										
	WEST LEG # 2 AND NORTH RANGE C										
IH$_{12}$	Brandt Island	**18" Pipeline**		16/18 Inch Pipeline							
	Annual				**50,750 cys**	$200,000	$6.08	$308,560	$640,786	$12.63	$640,786
	2-year Frequency				**101,500 cys**	$200,000	$4.64	$470,960	$845,410	$8.33	$422,705
	3-year Frequency				**152,250 cys**	$200,000	**$4.30**	$654,675	$1,076,891	$7.07	$358,964
	Mob/Demob shared with another contract where 18inch required i.e. within Morehead Harbor, AIWW, etc										
IH$_{13}$	ODMDS	Bucket & Barge	X	3,750 cy/load							
	Annual				**50,750 cys**	$185,000	$7.79	$395,343	$731,232	$14.41	$731,232
	2-year Frequency				**101,500 cys**	$185,000	$7.29	$739,935	$1,165,418	$11.48	$582,709
	3-year Frequency				**152,250 cys**	$185,000	$7.15	$1,088,588	$1,604,720	$10.54	$534,907
	Mob/Demob considered shared with NW-West dredging or S.Range C or within Morehead Harbor										
IH$_{14}$	ODMDS	**Hopper**	X	2,800 cy/load							
	Annual				**50,750 cys**	$185,000	$7.61	$386,208	$719,721	$14.18	$719,721
		NOT VIABLE - EQUIPMENT									
	2-year Frequency				**101,500 cys**	$185,000	$7.28	$738,920	$1,164,139	$11.47	$582,070
	3-year Frequency				**152,250 cys**	$185,000	$7.24	$1,102,290	$1,621,985	$10.65	$540,662
	Mob/Demob considered shared with within Morehead Harbor (S.Range C and N. Range B) or Wilmington Harbor Contract										
IH$_{15}$	Nearshore - WEST/EAST shallow	Bucket & Barge	X	2,250 cy/load							
IH$_{17}$	Annual				**50,750 cys**	$185,000	$8.29	$420,718	$763,204	$15.04	$763,204
	2-year Frequency				**101,500 cys**	$185,000	$7.49	$760,235	$1,190,996	$11.73	$595,498
	3-year Frequency				**152,250 cys**	$185,000	$7.41	$1,128,173	$1,654,597	$10.87	$551,532
	Mob/Demob considered shared with NW-West dredging or S.Range C or within Morehead Harbor										
IH$_{15a}$	Nearshore - WEST expanded	Bucket & Barge	X	3,750 cy/load							
	Annual				**50,750 cys**	$185,000	$7.67	$389,253	$723,558	$14.26	$723,558
	2-year Frequency				**101,500 cys**	$185,000	$7.39	$750,085	$1,178,207	$11.61	$589,104
	3-year Frequency				**152,250 cys**	$185,000	$7.06	$1,074,885	$1,587,455	$10.43	$529,152
	Mob/Demob considered shared with NW-West dredging or S.Range C or within Morehead Harbor										
IH$_{15b}$	Nearshore - WEST existing- new EAST	Bucket & Barge	X	3,750 cy/load							
IH$_{17a}$	Annual				**50,750 cys**	$185,000	$7.62	$386,715	$720,361	$14.19	$720,361
	2-year Frequency				**101,500 cys**	$185,000	$7.31	$741,965	$1,167,976	$11.51	$583,988
	3-year Frequency				**152,250 cys**	$185,000	$7.01	$1,067,273	$1,577,863	$10.36	$525,954
	Mob/Demob considered shared with NW-West dredging or S.Range C or within Morehead Harbor										
IH$_{16}$	Nearshore - WEST/EAST shallow	**Hopper**	X	2,000 cy/load							
IH$_{18}$	Annual				**50,750 cys**	$185,000	$8.69	$441,018	$788,782	$15.54	$788,782
		NOT VIABLE - EQUIPMENT									
	2-year Frequency				**101,500 cys**	$185,000	$8.47	$859,705	$1,316,328	$12.97	$658,164
	3-year Frequency				**152,250 cys**	$185,000	$8.39	$1,277,378	$1,842,596	$12.10	$614,199
	Mob/Demob considered shared with within Morehead Harbor (S.Range C and N. Range B) or Wilmington Harbor Contract										
IH$_{16a}$	Nearshore - WEST expanded	**Hopper**	X	2,550 cy/load							
	Annual				**50,750 cys**	$185,000	$7.61	$386,208	$719,721	$14.18	$719,721
		NOT VIABLE - EQUIPMENT									
	2-year Frequency				**101,500 cys**	$185,000	$7.50	$761,250	$1,192,275	$11.75	$596,138
	3-year Frequency				**152,250 cys**	$185,000	$7.32	$1,114,470	$1,637,332	$10.75	$545,777
	Mob/Demob considered shared with within Morehead Harbor (S.Range C and N. Range B) or Wilmington Harbor Contract										
IH$_{16b}$	Nearshore - WEST existing- new EAST	**Hopper**	X	2,550 cy/load							
IH$_{18a}$	Annual				**50,750 cys**	$185,000	$7.18	$364,385	$692,225	$13.64	$692,225
		NOT VIABLE - EQUIPMENT									
	2-year Frequency				**101,500 cys**	$185,000	$6.96	$706,440	$1,123,214	$11.07	$561,607
	3-year Frequency				**152,250 cys**	$185,000	$6.74	$1,026,165	$1,526,068	**$10.02**	$508,689
	Mob/Demob considered shared with within Morehead Harbor (S.Range C and N. Range B) or Wilmington Harbor Contract										
	SOUTH RANGE C -AND- NORTH RANGE B (25% of Range B Shoal Quantity)										
OH$_1$	BRANDT ISLAND	**18" Pipeline**									
	Annual				**115,450 cys**						
								Not a viable alternative-therefore not priced			
	2-year Frequency				**230,900 cys**						
	3-year Frequency				**346,350 cys**						
OH$_2$	ODMDS	Bucket & Barge	X	3,750 cy/load							
	Annual				**115,450 cys**	$185,000	$7.62	$879,729	$1,341,559	$11.62	$1,341,559
	2-year Frequency				**230,900 cys**	$185,000	$7.27	$1,678,643	$2,348,190	$10.17	$1,174,095
	3-year Frequency				**346,350 cys**	$185,000	$7.10	$2,459,085	$3,331,547	$9.62	$1,110,516
	Mob/Demob considered shared with other parts of Morehead City Harbor Dredging										
OH$_3$	ODMDS	**Hopper**	X	2,800 cy/load							
	Annual hopper window 120 days				**115,450 cys**	$275,000	$4.87	$562,242	$1,054,924	$9.14	$1,054,924
	2-year Frequency				**230,900 cys**	$275,000	$4.54	$1,048,286	$1,667,340	$7.22	$833,670
	3-year Frequency				**346,350 cys**	$275,000	$4.44	$1,537,794	$2,284,120	$6.59	$761,373
	Mob/Demob considered shared with Contract for Wilmington Ocean Bar Contract OR other parts of Morehead City										
OH$_4$	Nearshore - WEST existing- new EAST	Bucket & Barge	X	3,750 cy/load							
OH6a	Annual				**115,450 cys**	$185,000	$7.28	$840,476	$1,292,100	$11.19	$1,292,100
	2-year Frequency				**230,900 cys**	$185,000	$7.15	$1,650,935	$2,313,278	$10.02	$1,156,639
	3-year Frequency				**346,350 cys**	$185,000	$6.96	$2,410,596	$3,270,451	$9.44	$1,090,150
	Mob/Demob considered shared with other parts of Morehead City Harbor Dredging										

Attachment 4 (sheet 1 of 3) – Morehead City Harbor Detailed Costs for Viable Measures

Attachment 4 - Morehead City Harbor DMMP Detailed Costs for Viable Measures
Costs shown include quantities, unit prices, mob/demob, contingency, and average cost per dredging cycle for all measures shown in Attachment 3
Fuel Price = $3.00/Gallon

New ID	Range/Dredging Frequency/Disposal Location	Dredging Method				Dredging Quantity CY	Mob & Demob	Unit Price	Dredging Event Cost	with Contingency 26%	Effective Cost/cy	Average Cost Per Cycle
OH$_{4a}$	Nearshore - WEST expanded	Bucket & Barge	X		3,750 cy/load							
	Annual					115,450 cys	$185,000	$7.54	$870,493	$1,329,921	$11.52	$1,329,921
	2-year Frequency					230,900 cys	$185,000	$7.33	$1,692,497	$2,365,646	$10.25	$1,182,823
	3-year Frequency					346,350 cys	$185,000	$7.01	$2,427,914	$3,292,271	$9.51	$1,097,424
OH$_{4b}$	Nearshore - WEST/EAST shallow	Bucket & Barge	X		2,250 cy/load							
OH$_{6}$	Annual					115,450 cys	$185,000	$8.28	$955,926	$1,437,567	$12.45	$1,437,567
	2-year Frequency					230,900 cys	$185,000	$7.49	$1,729,441	$2,412,196	$10.45	$1,206,098
	3-year Frequency					346,350 cys	$185,000	$7.34	$2,542,209	$3,436,283	$9.92	$1,145,428
OH$_{5}$	Nearshore - WEST existing- new EAST	Hopper	X		2,550 cy/load							
OH7a	Annual hopper window 120 days					115,450 cys	$275,000	$4.67	$539,152	$1,025,831	$8.89	$1,025,831
	2-year Frequency					230,900 cys	$275,000	$4.35	$1,004,415	$1,612,063	$6.98	$806,031
	3-year Frequency possibly 2 hoppers required					346,350 cys	$275,000	$4.23	$1,465,061	$2,192,476	$6.33	$730,825
	Mob/Demob considered shared with Contract for Wilmington Ocean Bar Contract OR other parts of Morehead City											
OH$_{5a}$	Nearshore - WEST expanded	Hopper	X		2,550 cy/load							
	Annual hopper window 120 days					115,450 cys	$275,000	$5.08	$586,486	$1,085,472	$9.40	$1,085,472
	2-year Frequency					230,900 cys	$275,000	$4.55	$1,050,595	$1,670,250	$7.23	$835,125
	3-year Frequency possibly 2 hoppers required					346,350 cys	$275,000	$4.52	$1,565,502	$2,319,033	$6.70	$773,011
	Mob/Demob considered shared with Contract for Wilmington Ocean Bar Contract OR other parts of Morehead City											
OH$_{5b}$	Nearshore - WEST/EAST shallow	Hopper	X		2,000 cy/load							
OH$_{7}$	Annual hopper window 120 days					115,450 cys	$275,000	$5.91	$682,310	$1,206,210	$10.45	$1,206,210
	2-year Frequency					230,900 cys	$275,000	$5.28	$1,219,152	$1,882,632	$8.15	$941,316
	3-year Frequency possibly 2 hoppers required					346,350 cys	$275,000	$5.14	$1,780,239	$2,589,601	$7.48	$863,200
	Mob/Demob considered shared with Contract for Wilmington Ocean Bar Contract OR other parts of Morehead City											
OH$_{8}$	Beach Disposal (Bogue Banks)	18" Pipeline	X		16/18-INCH Pipeline S. RANGE C & RANGE B							
	Annual pipeline window 165 days					115,450 cys	$1,500,000	$10.39	$1,199,526	$3,401,402	$29.46	$3,401,402
	2-year Frequency					230,900 cys	$1,500,000	$8.20	$1,893,380	$4,275,659	$18.52	$2,137,829
	3-year Frequency					346,350 cys	$1,500,000	$8.20	$2,840,070	$5,468,488	$15.79	$1,822,829
	Mob/Demob Price NOT SHARED since considered beach pipeline and Pipeline for E.Leg reduced to combine with this area											
OH$_{9}$	Beach Disposal (Bogue Banks)	30" Pipeline	X									
	Annual pipeline window 165 days					115,450 cys	$148,000	$8.85	$1,021,733	$1,473,863	$12.77	$1,473,863
	2-year Frequency					230,900 cys	$407,000	$7.14	$1,648,626	$2,590,089	$11.22	$1,295,044
	3-year Frequency					346,350 cys	$407,000	$6.50	$2,251,275	$3,349,427	$9.67	$1,116,476
	Mob/Demob shared for smaller quantities assumed to be with S. Range B, Cut off & N. Range A											
OH$_{9a}$	NEARSHORE BY PIPELINE WEST-EAST	30" Pipeline	X									
OH$_{11a}$	Annual pipeline window 165 days					115,450 cys	$160,000	$10.81	$1,248,015	$1,774,098	$15.37	$1,774,098
	2-year Frequency					230,900 cys	$440,000	$9.17	$2,117,353	$3,222,265	$13.96	$1,611,132
	3-year Frequency					346,350 cys	$440,000	$8.80	$3,047,880	$4,394,729	$12.69	$1,464,910
	Mob/Demob shared for smaller quantities assumed to be with S. Range B, Cut off & N. Range A											
OH$_{10}$	Beach Disposal (SHACKLEFORD Banks)	18" Pipeline										
	Annual					115,450 cys	$1,500,000	$12.28	$1,417,726	$3,676,335	$31.84	$3,676,335
	2-year Frequency					230,900 cys	$1,500,000	$9.79	$2,260,511	$4,738,244	$20.52	$2,369,122
	3-year Frequency					346,350 cys	$1,500,000	$9.71	$3,363,059	$6,127,454	$17.69	$2,042,485
	Mob/Demob Price NOT SHARED since considered beach pipeline and Pipeline for E.Leg reduced to combine with this area											
OH$_{11}$	Beach Disposal (SHACKLEFORD Banks)	30" Pipeline										
	Annual					115,450 cys	$148,000	$9.70	$1,119,865	$1,597,510	$13.84	$1,597,510
	2-year Frequency					230,900 cys	$407,000	$7.89	$1,821,801	$2,808,289	$12.16	$1,404,145
	3-year Frequency					346,350 cys	$407,000	$7.05	$2,441,768	$3,589,447	$10.36	$1,196,482
	Mob/Demob shared for smaller quantities assumed to be with S. Range B, Cut off & N. Range A											
OH$_{11b}$	NEARSHORE BY PIPELINE WEST-EAST	18" Pipeline										
	Annual					115,450 cys	$1,500,000	$11.94	$1,378,473	$3,626,876	$31.42	$3,626,876
	2-year Frequency					230,900 cys	$1,500,000	$11.34	$2,618,406	$5,189,192	$22.47	$2,594,596
	3-year Frequency					346,350 cys	$1,500,000	$11.14	$3,858,339	$6,751,507	$19.49	$2,250,502
	Mob/Demob shared for smaller quantities assumed to be with S. Range B, Cut off & N. Range A											
	SOUTH RANGE B (75% of Range B Quantity), CUT-OFF, NORTH RANGE A - - TO STA 110+00											
OH$_{12}$	BRANDT ISLAND	18" Pipeline										
	Annual					886,050 cys			Not a viable alternative-therefore not priced			
	2-year Frequency					1,772,100 cys						
	3-year Frequency					2,658,150 cys						
OH$_{13}$	ODMDS	Bucket & Barge		X	3,750 cy/load							
	Annual					886,050 cys	$550,000	$7.56	$6,698,538	$9,133,158	$10.31	$9,133,158
	2-year Frequency					1,772,100 cys	$1,100,000	$7.13	$12,635,073	$17,306,192	$9.77	$8,653,096
	3-year Frequency					2,658,150 cys	$1,650,000	$6.94	$18,447,561	$25,322,927	$9.53	$8,440,976
	Mob/Demob --NOT--shared for large quantities (MAY BE SHARED if QUANTITIES SMALLER)											
OH$_{14}$	ODMDS	Hopper			2,800 cy/load							
	Annual					886,050 cys	$275,000	$4.24	$3,756,852	$5,080,134	$5.73	$5,080,134
	2-year Frequency				2 MOBS	1,772,100 cys	$1,100,000	$4.02	$7,123,842	$10,362,041	$5.85	$5,181,020
	3-year Frequency				3 MOBS	2,658,150 cys	$1,650,000	$3.98	$10,579,437	$15,409,091	$5.80	$5,136,364
	Mob/Demob --NOT--shared for large quantities (MAY BE SHARED if QUANTITIES SMALLER)											

Attachment 4 (sheet 2 of 3) – Morehead City Harbor Detailed Costs for Viable Measures

Attachment 4 - Morehead City Harbor DMMP Detailed Costs for Viable Measures

Costs shown include quantities, unit prices, mob/demob, contingency, and average cost per dredging cycle for all measures shown in Attachment 3

Fuel Price = $3.00/Gallon

New ID	Range/Dredging Frequency/Disposal Location	Dredging Method			Dredging Quantity CY	Mob & Demob	Unit Price	Dredging Event Cost	with Contingency 26%	Effective Cost/cy	Average Cost Per Cycle
OH$_{15}$	Nearshore - WEST existing- new EAST	Bucket & Barge	X	3,750 cy/load							
OH$_{17a}$	Annual				**886,050 cys**	$550,000	$7.24	$6,415,002	$8,775,903	$9.90	$8,775,903
	2-year Frequency			2 MOBS	**1,772,100 cys**	$1,100,000	$7.01	$12,422,421	$17,038,250	$9.61	$8,519,125
	3-year Frequency			3 MOBS	**2,658,150 cys**	$1,650,000	$6.91	$18,367,817	$25,222,449	$9.49	$8,407,483
	Mob/Demob --NOT--shared for large quantities (MAY BE SHARED if QUANTITIES SMALLER)										
OH$_{15a}$	Nearshore - WEST expanded	Bucket & Barge	X	3,750 cy/load							
	Annual				**886,050 cys**	$550,000	$7.47	$6,618,794	$9,032,680	$10.19	$9,032,680
	2-year Frequency			2 MOBS	**1,772,100 cys**	$1,100,000	$7.13	$12,635,073	$17,306,192	$9.77	$8,653,096
	3-year Frequency			3 MOBS	**2,658,150 cys**	$1,650,000	$6.95	$18,474,143	$25,356,420	$9.54	$8,452,140
OH$_{15b}$	Nearshore - WEST/EAST shallow	Bucket & Barge	X	2,250 cy/load							
OH$_{17}$	Annual				**886,050 cys**	$550,000	$8.20	$7,265,610	$9,847,669	$11.11	$9,847,669
	2-year Frequency			2 MOBS	**1,772,100 cys**	$1,100,000	$7.45	$13,202,145	$18,020,703	$10.17	$9,010,351
	3-year Frequency			3 MOBS	**2,658,150 cys**	$1,650,000	$7.18	$19,085,517	$26,126,751	$9.83	$8,708,917
OH$_{16}$	Nearshore - WEST existing- new EAST	**Hopper**		2,550 cy/load							
OH$_{18a}$	Annual				**886,050 cys**	**$275,000**	**$4.06**	$3,597,363	$4,879,177	$5.51	$4,879,177
	2-year Frequency			2 MOBS	**1,772,100 cys**	$1,100,000	$3.86	$6,840,306	$10,004,786	$5.65	$5,002,393
	3-year Frequency			3 MOBS	**2,658,150 cys**	$1,650,000	$3.80	$10,100,970	$14,806,222	$5.57	$4,935,407
	Mob/Demob --NOT--shared for large quantities (MAY BE SHARED if QUANTITIES SMALLER)										
OH$_{16a}$	Nearshore - WEST expanded	**Hopper**		2,550 cy/load							
	Annual				**886,050 cys**	$275,000	$4.34	$3,845,457	$5,191,776	$5.86	$5,191,776
	2-year Frequency			2 MOBS	**1,772,100 cys**	$1,100,000	$4.10	$7,265,610	$10,540,669	$5.95	$5,270,334
	3-year Frequency			3 MOBS	**2,658,150 cys**	$1,650,000	$4.05	$10,765,508	$15,643,539	$5.89	$5,214,513
	Mob/Demob --NOT--shared for large quantities (MAY BE SHARED if QUANTITIES SMALLER)										
OH$_{16b}$	Nearshore - WEST/EAST shallow	**Hopper**		2,000 cy/load							
OH$_{18}$	Annual				**886,050 cys**	$275,000	$4.87	$4,315,064	$5,783,480	$6.53	$5,783,480
	2-year Frequency			2 MOBS	**1,772,100 cys**	$1,100,000	$4.61	$8,169,381	$11,679,420	$6.59	$5,839,710
	3-year Frequency			3 MOBS	**2,658,150 cys**	$1,650,000	$4.54	$12,068,001	$17,284,681	$6.50	$5,761,560
	Mob/Demob --NOT--shared for large quantities (MAY BE SHARED if QUANTITIES SMALLER)										
OH$_{19}$	Beach Disposal(Shackleford and Bogue Banks)	**30" Pipeline**									
OH$_{21}$	Annual pipeline window 165 days				**886,050 cys**	$3,700,000	$8.73	$7,735,217	$14,408,373	$16.26	$14,408,373
		AVERAGE FOR THIS ALTERNATIVE				**$3,700,000**	**$7.82**	$10,386,721	$17,749,269	$13.35	$11,832,846
	2-year Frequency				**1,772,100 cys**	$3,700,000	$6.90	$12,227,490	$20,068,637	$11.32	$10,034,319
	3-year Frequency				**2,658,150 cys**	$3,700,000	$6.89	$18,314,654	$27,738,463	$10.44	$9,246,154
	Mob/Demob --NOT--shared for large quantities										
OH$_{19a}$	NEARSHORE BY PIPELINE WEST-EAST	**30" Pipeline**									
OH$_{21a}$	Annual pipeline window 165 days				**886,050 cys**	$4,000,000	$9.61	$8,514,941	$15,768,825	$17.80	$15,768,825
		AVERAGE FOR THIS ALTERNATIVE				$4,000,000	$8.75	$11,629,406	$19,693,052	$14.82	$13,128,701
	2-year Frequency				**1,772,100 cys**	$4,000,000	$7.89	$13,981,869	$22,657,155	$12.79	$11,328,577
	3-year Frequency				**2,658,150 cys**	$4,000,000	$7.54	$20,042,451	$30,293,488	$11.40	$10,097,829
	Mob/Demob --NOT--shared for large quantities										
OH$_{20}$	Beach Disposal (Bogue Banks)	**Hopper Pumpout**	X								
OH$_{22}$	Annual hopper window	USING 10,000 CY/DAY = 304,100CY/MO			**886,050 cys**	$945,000	$10.16	$9,002,268	$12,533,558	$14.15	$12,533,558
		1,216,400 CY PER HOPPER PER SEASON									
	2-year Frequency 2-hoppers required			2 MOBS	**1,772,100 cys**	$1,495,000	$10.00	$17,721,000	$24,212,160	$13.66	$12,106,080
	3-year Frequency			3 MOBS	**2,658,150 cys**	$2,045,000	$10.00	$26,581,500	$36,069,390	$13.57	$12,023,130
	Hopper with PUMPOUT TO BEACH Mob/Demob --NOT--shared for large quantities (MAY BE SHARED if QUANTITIES SMALLER)										
	SOUTH RANGE A - AND 110+00 OUT BOUND										
OEC$_2$	ODMDS from 110+00 outward	Bucket & Barge	X	3,750 cy/load							
	Annual				**114,500 cys**	$275,000	$7.41	$848,445	$1,415,541	$12.36	$1,415,541
	2-year Frequency				**229,000 cys**	$275,000	$7.02	$1,607,580	$2,372,051	$10.36	$1,186,025
	3-year Frequency				**343,500 cys**	$275,000	$6.36	$2,184,660	$3,099,172	$9.02	$1,033,057
	Mob/Demob considered shared with other parts of Morehead City Harbor Dredging										
OEC$_3$	ODMDS from 110+00 outward	**Hopper**	X	2,800 cy/load							
	Annual hopper window 90 days				**114,500 cys**	$275,000	$3.61	$413,345	$867,315	$7.57	$867,315
	2-year Frequency				**229,000 cys**	$275,000	$3.50	$801,500	$1,356,390	$5.92	$678,195
	3-year Frequency				**343,500 cys**	**$275,000**	**$3.50**	$1,202,250	$1,861,335	$5.42	$620,445
	Mob/Demob considered shared with Contract for Wilmington Ocean Bar Contract OR other parts of Morehead City Harbor										
	All other OEC-Outer Entrance Channel alternatives not considered vialble alternatives.										

Attachment 4 (sheet 3 of 3) – Morehead City Harbor Detailed Costs for Viable Measures

PRICE LEVEL FOR THESE ESTIMATES = JANUARY 2011

------ 1. Brandt Island - EXPAND Footprint of Existing Dike and Raise to 42, 43, 47, 52 & 55 ft
------ 2. Raise existing dike footprint to elevation from approximate elevation 39.5 ft to 45 ft
------ 3. Remove Material Inside Brandt Island (clean out) to ODMDS
------ 4. Create Bird Islands behind Shackleford Banks

RAISE DIKE WITH EXPANDED FOOTPRINT TO ELEVATIONS 42, 43, 47, 52, & 55 FT

1. FULL RAISE OF EXPANDED DIKES from existing - raise from existing elevation 2012 up to elevation shown
RAISE DIKE WITH EXPANDED FOOTPRINT TO ELEVATIONS 42, 47, ETC.

ELEVATION	QTY cy's	UNIT PRICE - Embankment	TOTAL	mob/demob	Mitigation Coastal Little Bluestem	clear/grub acres	clear and grub	NEW SPILLWAYS	seed/mulch	TOTAL Construction	WITH 25% Contingency	PED&S/A	DIKE Capacity (cy)	Capacity for dredge material - cy's	Cost/cy for Dredge capacity with contingency	AVG Pipelline to Brandt with MOB/DEMOB & contingency	**TOTAL EFF COST/CY to Brandt Island**	**AVG OF B+B TO ODMDS & NEARSHORE**
42 FT	442,157	$5.25	$2,321,324	$489,496	$75,000	84	$252,000	$630,000	$294,000	$4,061,820	$5,077,275	$718,023	1,690,723	1,445,000	$4.01	$6.13	**$10.14**	**$9.23**
43	485,112	$5.25	$2,546,837	$507,905	$75,000	84	$252,000	$630,000	$294,000	$4,305,742	$5,382,178	$737,842	1,853,878	1,527,000	$4.01	$6.13	**$10.14**	**$9.23**
47	656,931	$5.25	$3,448,888	$581,542	$75,000	84	$252,000	$630,000	$294,000	$5,281,430	$6,601,787	$817,116	2,506,497	2,153,000	$3.45	$6.13	**$9.58**	**$9.23**
52	917,100	$5.25	$4,814,775	$693,043	$75,000	84	$252,000	$630,000	$294,000	$6,758,818	$8,448,522	$937,154	3,300,624	2,850,000	$3.29	$6.13	**$9.42**	**$9.23**
55	1,088,300	$5.25	$5,713,575	$766,414	$75,000	84	$252,000	$630,000	$294,000	$7,730,989	$9,663,737	$1,016,143	3,771,856	3,386,000	$3.15	$6.13	**$9.28**	**$9.23**

2. RAISE EXISTING DIKE FOOTPRINT (FROM APPROXIMATELY 39,5 FT TO ELEVATION 45 FT) Capacity of existing dike without raise to 45 FT = 2,977,434 CY

ELEVATION	QTY cy's	UNIT PRICE - Embankment	TOTAL	mob/demob	Mitigation	clear/grub acres	total clear and grub	NEW SPILLWAY	costs for seed/mulch	TOTAL ALL COSTS	WITH 25% CONTINGENCY	PED&S/A	DIKE Capacity (cy)	Capacity for dredge material - cy's	Cost/cy for Dredge capacity with contingency	AVG Pipelline to Brandt with MOB/DEMOB & contingency	TOTAL EFF COST/CY to Brandt Island	**AVG OF B+B TO ODMDS & NEARSHORE**
45	135,000	$5.50	$742,500	$372,000	$0	10	$30,000	$315,000	$66,500	$1,526,000	$1,907,500	$286,125	622,566	311,283	$7.05	$6.13	**$13.18**	**$9.23**

3. CLEAN OUT BRANDT ISLAND - ONCE IT BECOMES FULL OF DREDGED MATERIAL

	QTY	UNIT PRICE	
MOB AND DEMOB - dredge & land equipment	1 LS	$1,000,000	$1,000,000
Dredge ENTRANCE TO CUT INTO DIKE	100,000 cy	$7.00	$700,000
Dredge Interior and place into ODMDS	3,812,000 cy	$7.00	$26,684,000
REPLACE-REINSTALL DIKE	100,000 cy	$7.00	$700,000
NEW SPILLWAYS, BONDS ETC	$872,520		$875,000
TOTAL			$29,959,000

PED & S/A	Total with 20% contingency	Cost/cy of capacity
$898,770	$37,029,324	$9.71 /CY

4. MOREHEAD CITY HARBOR CREATION OF BIRD ISLANDS FROM DREDGED MATERIAL

15 ACRE SITE(S) BEHIND SHACKLEFORD BANKS		
Enclosure will be by geotube filled sandbags	Based on pi Rsq = area	
	radius = 457 ft	
	circumference = 2,865 LF of geotube	
Average water depth to fill 15 acre site = 5 ft x 653,400 sf =	121,000	cy
Material dredged from channel to fill inside geotubes of 121,000 cy		$2,904,000
Assume----------- 242,000 cy to result in 121,000 cy inside at $12/cy		
Cost of geotubes filled with nearby sand for height of 5 feet approximately		
		$1,148,000
Misc Mob-Demob for equipment costs on Island, Geotube mob/demob		$500,000
COST FOR 1-BIRD ISLAND	TOTAL	**$4,552,000**
	WITH 25% conting	**$5,690,000**
		PER ISLAND

AVERAGE Pipeline unit price To Brandt Island	
Pipeline costs Inner Harbor (with MOB/DEMOB and 20% contingency	
$2,126,598	IH-1 pipeline to Brandt- $5.87/cy * 362,250 cy
$1,025,610	IH-12 pipeline to Brandt- $6.74/cy * 152,250 cy
$3,152,208	Total Pipeline cost with mob/demob & contingency
514,500 cy	
$6.13 /cy	Average pipeline cost to Brandt Island
AVERAGE B+B unit price To ODMDS & Nearshore	
FOR 3 YEAR CYCLE	
$3,295,329	IH-2 Bucket/Barge to ODMDS- $9.10/cy * 362,250 cy
$1,453,398	IH-16b Bucket/Barge to Nearshore- $9.55/cy * 152,250cy
$4,748,727	Total B+B cost with mob/demob and contingency
514,500 cy	
$9.23 /cy	Avg cost for Bucket/Barge to ODMDS & NEARSHORE

Attachment 5 - Morehead City Harbor DMMP cost considerations for alternative comparisons

Attachment 6 – Total Project Cost (TPC) (4 pages)

Total Project Cost (TPCS) BASICS:
A completed TPCS will show the overall project cost by feature account of a project and an estimate of the total cost to complete the project(fully funded estimate). It is essentially a summary of a program's cost by summing each construction contract by WBS feature and its estimated lands damages and associated administrative costs. These costs are escalated to the midpoint of construction and summed to give a fully funded cost.
Things you need to complete a TPCS:
Projected budget year planned to obtain funding to support the project development and construction.
Effective price level date of estimate.
Estimate of construction costs for the appropriate work breakdown structure.
Estimates for other accounts (lands, damages, real estate, relocations, etc)
Midpoint of construction schedule.
Midpoint of design schedule.
Midpoint of Lands and Damages, Relocations...
30/31 accounts estimates or they may be calculated based on rule of thumb percentages (default on the spreadsheet).
Risk Based contingencies.
Current CWCCIS table (updated 2x per year, Mar and Sep) Downloadable from NWW's web site.
Other data that may be nice to know: (you will need this for the 902 limit)
Authorization legislation and date.
Baseline estimate (estimate presented to Congress for authorization) Most likely in a report by the Chief of Engineers. You need this for the Work Breakdown Structure (WBS) to track changes in the project.
Amount actually authorized by Congress.
Contracts awarded, contracts ongoing and the respective WBS code and amount (contingencies on completed work and ongoing construction are less than future construction work)
Total of expenditures by WBS feature and year.
Total project cost spreadsheet sums the account costs for a project/program based on the estimate data entered and will calculate the 30/31 accounts based on the percentages input into the data sheet.(For the 30/31 accounts the spreadsheet default is to use the rule of thumb percentages from the data sheet. These may be changed accordingly either thru changing the percentages in the data sheet or may be adjusted for each item individually. (The Excel goal seeking function may be useful))
Things to remember:
- Estimates should be less than two years old (ER 1110-2-1302).
- Make sure you are using the latest CWCCIS table/numbers for your TPCS!
- Check that the costs are reasonable for where you are at in the stage of the project! I.e.- If you have already completed the bid package for a contract and have it on the shelf you most likely have expended most of the design cost. Therefore the rule of thumb 30/31 account percentages and amounts may be too high.
How it works:
Each estimate for the project/program is entered on a separate page of the TPCS The estimate value (from MCACES)is entered in the left column of the page. Contingency is entered and the sum of the estimate and the total is calculated. Based on the date of the price level of the estimate, inflation is applied to bring the cost to the desired program year (middle column). From here the construction estimate is inflated to the midpoint of construction.
All of the estimates sum up to the top sheet (summary-it's the one with the signature blocks on it). It is important to remember to check that the sheets sum correctly by WBS structure. Don't mix accounts!

Fully Funded Contracts that have had funds obligated but not expended usually are entered at fully funded award price with 10% contingency. In general they are assumed to be at program year price level.
For a non fully funded contract that have been awarded escalation to the midpoint may be required. For this situation, make sure that you have an accurate total of estimated costs.
TPCS Sheet. Generally Obligations should be entered as an estimate and expenditures should be totaled and put in the spent thru column on the summary page. The key is to exclude contingency and escalation on spent funds.
GENERAL INSTRUCTIONS:
This worksheet is setup to include a summary sheet and four (4) separate contracts with one Construction WBS code. If more "Contract" sheets are added, or you need to have multiple Construction WBS codes then:
1- Fill out project data- this will populate the signatory blocks, program year, preparation date, etc.
2 - Change the "Sum" in reference column 3 to sum correctly to the sheets below,
3- Copy the revised formulas in column 3 to columns 4, 9 & 10, 15 & 16
4 - Use row "X" to check the summation of the spreadsheet.
5 - Select the appropriate Quarter for each item. Indexes & Time Period dates will come automatically. Check Time Periods.
6 Select Feature WBS. Feature description will come in automatically.
7- Enter the amounts spent thru the past Fiscal year in the appropriate cells in reference column 13 on the summary page

PROJECT LOCATION	Morehead City, North Carolina
PROGRAM YEAR	2015
ESTIMATE PREPARED DATE	2/9/2012
EST EFF. PRICE LEVEL DATE	1/1/2011
DATE TPCS PREPARED	10/14/2012
ENGINEERING REPORT AS BASIS	DMMP

			Districts Vary			
ENGINEERING & DESIGN PHASE -> 30 ACCOUNT						
PROJECT MANAGER,	Program Management:	2.5%	0.5%	30.0	6.8%	Sum per % of 30 Account
CHIEF, DPM,				30.0		
CHIEF, PLANNING,	Planning & Environmental Compliance:	1.0%	0.5%	30.0		
CHIEF, ENGINEERING,	Engineering & Design:	15.0%	3.3%	30.0		
CHIEF, COST ENGINEERING,						
CHIEF, ENGINEERING,	Engineering Tech Review & VE:	1.0%	0.5%	30.0		
CHIEF, CONTRACTING,	Contracting & Reprographics:	1.0%	0.5%	30.0		
CHIEF, ENGINEERING,	Engineering During Construction:	3.0%	0.5%	30.0		Escalate to Mid Point Construction
CHIEF, PLANNING,	Planning During Construction	2.0%	0.5%	30.0		
CHIEF, OPERATIONS,	Project Operation:	1.0%	0.5%	30.0		
CONSTRUCTION PHASE -> 31 ACCOUNT						
CHIEF, CONSTRUCTION,	Supervision & Assurance:	10.0%	4.0%	31.0	8.0%	Sum per % of 31 Account
CHIEF, OPERATIONS,	Project Operation:	2.0%	2.0%	30.0		
CHIEF, DPM,	Program Management:	2.5%	2.0%	31.0		
					14.8%	Sum per % of 30 & 31 Accounts
REAL ESTATE -> 01 ACCOUNT						
CHIEF, REAL ESTATE,						
CULTURAL RESOURCES -> 18 ACCOUNT						
CHIEF, PLANNING,						
SPENT THRU FYXX COSTS						
CHIEF, DPM,						

%'s are based on construction dollars amounts.
Accept default distribution of 30 and 31 accounts
or
Enter your preferred percentages
or
Use Goal Seek on each individual line within the TPCS spreadsheet to make the estimate match a 564

	Estimate Prepared: 9-Feb-12 Effective Price Level: 1-Jan-11					Program Year (Budget EC): 2015 Effective Price Level Date: 1 OCT 14				FULLY FUNDED PROJECT ESTIMATE				
				RISK BASED										
	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
	B	C	D	E	F	G	H	I	J	P	L	M	N	O
FY2015														
	CONTRACT COST TOTALS:	$13,997	$3,639	26.0%	**$17,636**		$14,655	$3,810	$18,465	2012Q4	0.4%	$14,719	$3,827	**$18,546**
FY2016														
	CONTRACT COST TOTALS:	$5,396	$1,403	26.0%	**$6,799**		$5,653	$1,470	$7,123	2013Q3	2.3%	$5,786	$1,504	**$7,290**
FY2017														
	CONTRACT COST TOTALS:	$8,678	$2,256	26.0%	**$10,934**		$9,096	$2,365	$11,461	2014Q3	4.4%	$9,494	$2,468	**$11,962**
FY2018														
	CONTRACT COST TOTALS:	$13,997	$3,639	26.0%	**$17,636**		$14,655	$3,810	$18,465	2015Q3	6.2%	$15,567	$4,047	**$19,614**
FY2019														
	CONTRACT COST TOTALS:	$5,396	$1,403	26.0%	**$6,799**		$5,653	$1,470	$7,123	2016Q3	8.3%	$6,122	$1,592	**$7,714**
FY2020														
	CONTRACT COST TOTALS:	$8,678	$2,256	26.0%	**$10,934**		$9,096	$2,365	$11,461	2017Q3	10.5%	$10,052	$2,614	**$12,666**
FY2021														
	CONTRACT COST TOTALS:	$13,997	$3,639	26.0%	**$17,636**		$14,655	$3,810	$18,465	2018Q3	12.3%	$16,458	$4,279	**$20,737**
FY2022														
	CONTRACT COST TOTALS:	$5,396	$1,403	26.0%	**6,799**		$5,653	$1,470	$7,123	2019Q3	14.6%	$6,477	$1,684	**$8,161**
FY2023														
	CONTRACT COST TOTALS:	$8,678	$2,256	26.0%	**$10,934**		$9,096	$2,365	$11,461	2020Q3	17.0%	$10,639	$2,766	**$13,405**
FY2024														
	CONTRACT COST TOTALS:	$13,997	$3,639	26.0%	**$17,636**		$14,655	$3,810	$18,465	2021Q3	18.7%	$17,397	$4,523	**$21,920**
FY2025														
	CONTRACT COST TOTALS:	$5,396	$1,403	26.0%	**$6,799**		$5,653	$1,470	$7,123	2022Q3	21.2%	$6,850	$1,781	**$8,631**
FY2026														
	CONTRACT COST TOTALS:	$8,678	$2,256	26.0%	**$10,934**		$9,096	$2,365	$11,461	2023Q3	23.8%	$11,257	$2,927	**$14,184**
FY2027														
	CONTRACT COST TOTALS:	$13,997	$3,639	26.0%	**$17,636**		$14,655	$3,810	$18,465	2024Q3	25.5%	$18,386	$4,780	**$23,166**
FY2028														
	CONTRACT COST TOTALS:	$5,396	$1,403	26.0%	**$6,799**		$5,653	$1,470	$7,123	2025Q3	28.1%	$7,243	$1,883	**$9,126**
FY2029 INNER TO ODMDS														
	CONTRACT COST TOTALS:	$10,069	$2,618	26.0%	**$12,687**		$10,550	$2,743	$13,293	2026Q3	30.7%	$13,784	$3,584	**$17,368**
FY2030														
	CONTRACT COST TOTALS:	$13,997	$3,639	26.0%	**$17,636**		$14,655	$3,810	$18,465	2027Q3	32.6%	$19,430	$5,052	**$24,482**
FY2031														
	CONTRACT COST TOTALS:	$5,396	$1,403	26.0%	**$6,799**		$5,653	$1,470	$7,123	2028Q3	35.5%	$7,658	$1,991	**$9,649**
FY2032 INNER TO ODMDS														
	CONTRACT COST TOTALS:	$10,069	$2,618	26.0%	**$12,687**		$10,550	$2,743	$13,293	2029Q3	38.2%	$14,576	$3,790	**$18,366**
FY2033														
	CONTRACT COST TOTALS:	$13,997	$3,639	26.0%	**$17,636**		$14,655	$3,810	$18,465	2030Q3	40.1%	$20,533	$5,338	**$25,871**
FY2034														
	CONTRACT COST TOTALS:	$5,396	$1,403	26.0%	**$6,799**		$5,653	$1,470	$7,123	2031Q3	43.2%	$8,096	$2,105	**$10,201**

Attachment 7 – Abbreviated Cost Risk Analysis (10 pages)

Abbreviated Risk Analysis

Project (less than $40M): **Morehead City Harbor - DMMP - Morehead City, NC**

Project Development Stage: **Feasibility (Recommended Plan)**

Risk Category: **Low: Simple-No Life Safety**

Dredge Material Management Plan (DMMP) 2015 thru 2034

Total Construction Contract Cost = $ 26,665,688 Represents 3-YEARS of Dredging

	WBS	Potential Risk Areas	No PED or S&A Contract Cost		% Contingency	$ Contingency	Total
1	12 02 HARBORS	Pipeline Dredge INNER to Brandt Island -- MCACES Year 3 and then ODMDS years 2029 & 2032	$ 2,628,300		21.47%	$ 564,204	$ 3,192,504.16
2	12 02 HARBORS	Hopper Dredge ENTRANCE to Nearshore - MCACES Years 2 and 3	$ 8,281,500		21.47%	$ 1,777,749	$ 10,059,248.64
3	12 02 HARBORS	Pipeline Dredge ENTRANCE to Beaches - - MCACES Year 1	$ 12,984,000		32.73%	$ 4,250,305	$ 17,234,304.53
4	12 02 HARBORS	Hopper Dredge Outer Entrance to ODMDS -- MCACES Year 3	$ 1,479,000		21.47%	$ 317,490	$ 1,796,489.61
5	12 02 HARBORS	Physical Monitoring and Surveys (3-years)	$ 1,292,888		7.21%	$ 93,250	$ 1,386,137.73
12		Remaining Construction Items	$ -	*0.0%*			
13	30 PLANNING, ENGINEERING, AND DESIGN	Planning, Engineering, & Design	$ 761,185		9.22%	$ 70,167	$ 831,351.86
14	31 CONSTRUCTION MANAGEMENT	Construction Management	$ 642,957		9.22%	$ 59,268	$ 702,225.47

Totals				
Total Construction Estimate	$ 26,665,688	26.26%	$ 7,002,997	$ 33,668,685
Total Planning, Engineering & Design	$ 761,185	9.22%	$ 70,167	$ 831,352
Total Construction Management	$ 642,957	9.22%	$ 59,268	$ 702,225
Total	$ 28,069,830	25.41%	$ 7,132,432	$ 35,202,262
		Overall USE 26%		

Abbreviated Risk Analysis

Morehead City Harbor - DMMP - Morehead City, NC
Feasibility (Recommended Plan)

Meeting Date: 30-Oct-12

PDT Members
Note: PDT involvement is commensurate with project size and involvement.

Project Management:	Bob Keistler
Planner:	
Study Manager:	Jenny Owens
Contracting:	
Real Estate:	
Relocations:	
Economics:	Chris Graham
Engineering & Design:	Lee Danley
Technical Lead:	
Geotech:	Ben Lackey
Hydrology:	Kevin Conner
Civil:	Jimmy Hargrove
Environmental:	Hugh Heine
Cultural Resources:	John Mayer
Electrical:	
Cost Engineering:	John Caldwell
Construction:	
Operations:	

Morehead City Harbor - DMMP - Morehead City, NC

Feasibility (Recommended Plan)

Abbreviated Risk Analysis

Meeting Date: 30 Oct 2012

Risk Level

	Negligible	Marginal	Significant	Critical	Crisis
Very Likely	2	3	4	5	5
Likely	1	2	3	4	5
Possible	0	1	2	3	4
Unlikely	0	0	1	2	3

Risk Element	Potential Risk Areas	Concerns Pull Down Tab (ENABLE MACROS THRU TRUST CENTER) (Choose ALL that apply)	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Likelihood	Impact	Risk Level
Project Scope Growth							
						Max Potential Cost Growth	40%
PS-1	Pipeline Dredge INNER to Brandt Island --- MCACES Year 3 and then ODMDS years 2029 & 2032	• Potential for scope growth, added features and quantities?	INNER HARBOR • Potential for scope growth, added features and quantities? FULL FUNDING may not be provided ANNUALLY for dredging all quantities needed to be removed.	If funding is not sufficient and quantities have to be reduced, then smaller quantities may cause increase in unit pricing if bank heights are not optimal.	Likely	Negligible	1
PS-2	Hopper Dredge ENTRANCE to Nearshore - MCACES Years 2 and 3	• Project accomplish intent?	ENTRANCE CHANNEL SAME AS PS-1	Smaller quantities may cause increase in unit pricing if bank heights are not optimal. NEW NEARSHORE disposal areas give some flexibility options - HOWEVER, this could also leave more material in channel that PIPELINE TO BEACHES would have to dredge during PS-3.	Likely	Negligible	1
PS-3	Pipeline Dredge ENTRANCE to Beaches -- MCACES Year 1	• Project accomplish intent?	ENTRANCE CHANNEL SAME AS PS-1	Pipeline contract quantities TO THE BEACH may need to be larger than normal 3 year cycle rotation because material was not removed in other years (PS-2).	Likely	Significant	3
PS-4	Hopper Dredge Outer Entrance to ODMDS -- MCACES Year 3	• Project accomplish intent?	OUTER ENTRANCE SAME AS PS-1	OUTER BAR is not impacted as much as significant a change in scope and could be done with other HOPPER contracts. But still anticipate unit price increase.	Likely	Negligible	1
PS-5	Physical Monitoring and Surveys (3-years)	• Project accomplish intent?	NO CONCERNS - Scope and costs are well defined.		Possible	Negligible	0
PS-6	Planning, Engineering, & Design	• Potential for scope growth, added features and quantities?	NO CONCERNS - Requirments for PED for O&M dredging are based on historical data and well defined costs.		Unlikely	Negligible	0
PS-7	Construction Management	• Potential for scope growth, added features and quantities?	NO CONCERNS - Requirments for S&A for O&M dredging are based on historical data and well defined costs.		Unlikely	Negligible	0

Acquisition Strategy							
					Max Potential Cost Growth		30%
Risk Element	**Potential Risk Areas**	**Concerns Pull Down Tab (ENABLE MACROS THRU TRUST CENTER) (Choose ALL that apply)**	**Concerns**	**PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)**	**Likelihood**	**Impact**	**Risk Level**
AS-1	Pipeline Dredge INNER to Brandt Island --- MCACES Year 3 and then ODMDS years 2029 & 2032	• Limited bid competition anticipated?	• Limited BID COMPETITIONS anticipated? The sooner the bid opening acquisition the more competition there will be for dredging.	For best competition and timing of bids to be out early in the dredge year (beginning NOVEMBER 15). BID OPENING should not be later than OCTOBER 15 If not early, bids could possibly be significantly higher.	Possible	Significant	2
AS-2	Hopper Dredge ENTRANCE to Nearshore - MCACES Years 2 and 3	• Limited bid competition anticipated?	SAME CONCERNS AS RISK ELEMENT AS-1	SAME CONCLUSIONS RISK ELEMENT AS-1	Possible	Significant	2
AS-3	Pipeline Dredge ENTRANCE to Beaches -- MCACES Year 1	• Limited bid competition anticipated?	SAME CONCERNS AS RISK ELEMENT AS-1 • Limited bid competition anticipated?	SAME CONCLUSIONS RISK ELEMENT AS-1	Possible	Significant	2
AS-4	Hopper Dredge Outer Entrance to ODMDS -- MCACES Year 3	• Limited bid competition anticipated?	SAME CONCERNS AS RISK ELEMENT AS-1 • Limited bid competition anticipated?	SAME CONCLUSIONS RISK ELEMENT AS-1	Possible	Significant	2
AS-5	Physical Monitoring and Surveys (3-years)	• Limited bid competition anticipated?	Additional -Cultural resource investigations may be necessary for PIPELINE DISCHARGE directly into nearshore disposal areas. • Limited bid competition anticipated?	Contract acquisition for surveys may require additional investigations for cultural resources in nearshore disposal areas.	Possible	Significant	2
AS-6	Planning, Engineering, & Design	• Limited bid competition anticipated?	NO CONCERNS - Requirments for PED for O&M dredging are based on historical data and well defined costs. • Limited bid competition anticipated?		Unlikely	Negligible	0
AS-7	Construction Management	• Limited bid competition anticipated?	NO CONCERNS - Requirments for S&A for O&M dredging are based on historical data and well defined costs. • Limited bid competition anticipated?		Unlikely	Negligible	0

Construction Elements							
					Max Potential Cost Growth		15%
Risk Element	Potential Risk Areas	Concerns Pull Down Tab (ENABLE MACROS THRU TRUST CENTER) (Choose ALL that apply)	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Likelihood	Impact	Risk Level
CE-1	Pipeline Dredge INNER to Brandt Island --- MCACES Year 3 and then ODMDS years 2029 & 2032	• Accelerated schedule or harsh weather schedule?	• Accelerated schedule or harsh weather schedule? • Unique construction methods?	EFFECTIVE WORK TIME % used in CEDEP. Safe harbor is not considered as significant costs since this work is for INNER HARBOR but in years when bucket and barge 2029 & 2032 there may be some additional costs for occasionally not being able to transport offshore due to weather. - - - - Only unique construction methods may be string bean shoals or areas where dredge is more inefficient than historical average.	Likely	Negligible	1
CE-2	Hopper Dredge ENTRANCE to Nearshore - MCACES Years 2 and 3	• Accelerated schedule or harsh weather schedule?	• Accelerated schedule or harsh weather schedule? • Unique construction methods?	Historical weather was considered in the EFFECTIVE WORK TIME % USED IN CEDEP. Safe harbor is not considered as significant since BY HOPPER isn't hard to move in & out of safe HARBOR. - - Only unique construction methods may be string bean shoals or areas where dredge is more inefficient than historical average.	Likely	Negligible	1
CE-3	Pipeline Dredge ENTRANCE to Beaches -- MCACES Year 1	• Accelerated schedule or harsh weather schedule?	• Accelerated schedule or harsh weather schedule? • Unique construction methods?	Historical weather was considered in the EFFECTIVE WORK TIME % USED IN CEDEP. Safe harbor is not considered as significant since HARBOR is so close by but it may be likely. Only unique construction methods may be string bean shoals or areas where dredge is more inefficient than historical average.	Likely	Negligible	1
CE-4	Hopper Dredge Outer Entrance to ODMDS -- MCACES Year 3	• Accelerated schedule or harsh weather schedule?	• Accelerated schedule or harsh weather schedule? • Unique construction methods?	Historical weather was considered in the EFFECTIVE WORK TIME % USED IN CEDEP. Safe harbor is not considered as significant since BY HOPPER isn't hard to move in & out of safe HARBOR. - - Only unique construction methods may be string bean shoals or areas where dredge is more inefficient than historical average.	Likely	Negligible	1
CE-5	Physical Monitoring and Surveys (3-years)	• Accelerated schedule or harsh weather schedule?	NO CONCERNS - Requirments for monitoring and surveys for O&M dredging are based on historical data and well defined costs.		Unlikely	Negligible	0
CE-6	Planning, Engineering, & Design	• Accelerated schedule or harsh weather schedule?	NO CONCERNS - Requirments for PED for O&M dredging are based on historical data and well defined costs.		Unlikely	Negligible	0
CE-7	Construction Management	• Accelerated schedule or harsh weather schedule?	NO CONCERNS - Requirments for S&A for O&M dredging are based on historical data and well defined costs.		Unlikely	Negligible	0

Quantities for Current Scope

Risk Element	Potential Risk Areas	Concerns Pull Down Tab (ENABLE MACROS THRU TRUST CENTER) (Choose ALL that apply)	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Likelihood	Impact	Risk Level
						Max Potential Cost Growth	20%
Q-1	Pipeline Dredge INNER to Brandt Island --- MCACES Year 3 and then ODMDS years 2029 & 2032	• Appropriate methods applied to calculate quantities?	• Sufficient investigations to develop quantities? Historical shoaling and quantities were evaluated for quantity expectations. • Appropriate methods applied to calculate quantities? Many alternatives considered in quantity development.	Quantities have been monitored for many years and was consistent including smaller storm patterns that may cause some changes in quantities. Major named storms or Hurricanes are historically addressed under separate funding and should not be considered for this risk analysis.	Likely	Negligible	1
Q-2	Hopper Dredge ENTRANCE to Nearshore - MCACES Years 2 and 3	• Appropriate methods applied to calculate quantities?	SAME AS Q-1 • Appropriate methods applied to calculate quantities?	SAME CONCLUSIONS AS Q-1	Likely	Negligible	1
Q-3	Pipeline Dredge ENTRANCE to Beaches -- MCACES Year 1	• Appropriate methods applied to calculate quantities?	SAME AS Q-1 • Appropriate methods applied to calculate quantities?	Quantity changes for pipeline dredging may be more significant in cost increase than quantities in years for nearshore - above Q-2.	Likely	Significant	3
Q-4	Hopper Dredge Outer Entrance to ODMDS -- MCACES Year 3	• Appropriate methods applied to calculate quantities?	SAME AS Q-1 • Appropriate methods applied to calculate quantities?	SAME CONCLUSIONS AS Q-1	Likely	Negligible	1
Q-5	Physical Monitoring and Surveys (3-years)	• Appropriate methods applied to calculate quantities?	Scope and costs may some repetitive evaluations to finalize quantity shoaling because of storms and DMMP dredge performance. • Appropriate methods applied to calculate quantities?	It is possible that additional monitoring and surveys could be significant increase because of storm events AND require more surveys to evaluate sholaing.	Possible	Significant	2
Q-6	Planning, Engineering, & Design	• Level of confidence based on design and assumptions?	NO CONCERNS - Requirments for PED for O&M dredging are based on historical data and well defined costs.		Unlikely	Negligible	0
Q-7	Construction Management	• Level of confidence based on design and assumptions?	NO CONCERNS - Requirments for S&A for O&M dredging are based on historical data and well defined costs.		Unlikely	Negligible	0

Specialty Fabrication or Equipment

Risk Element	Potential Risk Areas	Concerns Pull Down Tab (ENABLE MACROS THRU TRUST CENTER) (Choose ALL that apply)	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Likelihood	Impact	Risk Level
						Max Potential Cost Growth	50%
FE-1	Pipeline Dredge INNER to Brandt Island --- MCACES Year 3 and then ODMDS years 2029 & 2032	• Risk of specialty equipment functioning first time? Test?	NO CONCERNS FOR FABRICATION OR EQUIPMENT		Unlikely	Negligible	0
FE-2	Hopper Dredge ENTRANCE to Nearshore - MCACES Years 2 and 3	• Unusual parts, material or equipment manufactured or installed?	NO CONCERNS FOR FABRICATION OR EQUIPMENT		Unlikely	Negligible	0
FE-3	Pipeline Dredge ENTRANCE to Beaches -- MCACES Year 1	• Unusual parts, material or equipment manufactured or installed?	NO CONCERNS FOR FABRICATION OR EQUIPMENT		Unlikely	Negligible	0
FE-4	Hopper Dredge Outer Entrance to ODMDS -- MCACES Year 3	• Unusual parts, material or equipment manufactured or installed?	NO CONCERNS FOR FABRICATION OR EQUIPMENT		Unlikely	Negligible	0
FE-5	Physical Monitoring and Surveys (3-years)	• Unusual parts, material or equipment manufactured or installed?	NO CONCERNS FOR FABRICATION OR EQUIPMENT		Unlikely	Negligible	0
FE-6	Planning, Engineering, & Design	• Unusual parts, material or equipment manufactured or installed?	NO CONCERNS FOR FABRICATION OR EQUIPMENT		Unlikely	Negligible	0
FE-7	Construction Management	• Unusual parts, material or equipment manufactured or installed?	NO CONCERNS FOR FABRICATION OR EQUIPMENT		Unlikely	Negligible	0

Cost Estimate Assumptions

							Max Potential Cost Growth	25%
Risk Element	Potential Risk Areas	Concerns Pull Down Tab (ENABLE MACROS THRU TRUST CENTER) (Choose ALL that apply)	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Likelihood	Impact	Risk Level	
CT-1	Pipeline Dredge INNER to Brandt Island --- MCACES Year 3 and then ODMDS years 2029 & 2032	• Assumptions regarding crew, productivity, overtime?	• Assumptions regarding crew, productivity, overtime?	Estimate development and assumptions are consistent with historical O&M dredging methods, factors, and bids. PDT doesn't expect any major differences in the future. Cost methods similar to historic still could be neglible cost growth.	Likely	Negligible	1	
CT-2	Hopper Dredge ENTRANCE to Nearshore - MCACES Years 2 and 3	• Assumptions regarding crew, productivity, overtime?	SAME AS CT-1 CONCERNS	SAME AS CT-1	Likely	Negligible	1	
CT-3	Pipeline Dredge ENTRANCE to Beaches -- MCACES Year 1	• Assumptions regarding crew, productivity, overtime?	SAME AS CT-1 CONCERNS	SAME AS CT-1	Likely	Negligible	1	
							FALSE	
							FALSE	
CT-6	Planning, Engineering, & Design	• Reliability and number of key quotes?	Requirments for PED for O&M dredging are based on historical data and well defined costs.	Although costs well defined, it is possible for marginal increases.	Possible	Marginal	1	
CT-7	Construction Management	• Reliability and number of key quotes?	Requirments for S&A for O&M dredging are based on historical data and well defined costs.	Although costs well defined, it is possible for marginal increases.	Possible	Marginal	1	

External Project Risks

Risk Element	Potential Risk Areas	Concerns Pull Down Tab (ENABLE MACROS THRU TRUST CENTER) (Choose ALL that apply)	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Likelihood	Impact	Risk Level
						Max Potential Cost Growth	20%
EX-1	Pipeline Dredge INNER to Brandt Island --- MCACES Year 3 and then ODMDS years 2029 & 2032	• Unanticipated inflations in fuel, key materials?	• Potential for severe adverse weather? Covered by emergency funding. • Political influences, lack of support, obstacles? Funding under SCOPE OF WORK elements of RISK. • Unanticipated inflations in fuel, key materials? FUEL is the biggest item for fluctuation as high as $4.00/gallon historically. • Potential for market volatility impacting competition, pricing? Competition addressed in ACQUISITION STRATEGY which carries a greater weight overall.	Fuel fluctuations will always be concern and could effect range of pricing. CEDEP estimates could vary from current estimate of $3.00/gallon used to $4.00/gallon which is considered significant.	Likely	Significant	3
EX-2	Hopper Dredge ENTRANCE to Nearshore - MCACES Years 2 and 3	• Unanticipated inflations in fuel, key materials?	SAME CONCERNS AS EX-1 • Unanticipated inflations in fuel, key materials?	SAME CONCLUSIONS AS EX-1	Likely	Significant	3
EX-3	Pipeline Dredge ENTRANCE to Beaches -- MCACES Year 1	• Unanticipated inflations in fuel, key materials?	SAME CONCERNS AS EX-1 • Unanticipated inflations in fuel, key materials?	SAME CONCLUSIONS AS EX-1	Likely	Significant	3
							FALSE
							FALSE
EX-6	Planning, Engineering, &	• Political influences, lack of support, obstacles?	Requirments for PED for O&M dredging are based on historical data and well defined costs; however,	Engineering and Design Requirements for Environmental compliance could possibly change	Possible	Significant	2
EX-7	Construction Management	• Political influences, lack of support, obstacles?	based on historical data and well defined costs; however, future requirements for environmental	environmental compliance could possibly change and increase costs during construction.	Possible	Significant	2

Morehead City Harbor - DMMP - Morehead City, NC

Feasibility (Recommended Plan)

Abbreviated Risk Analysis

Typical Risk Elements	Potential Risk Areas: Pipeline Dredge INNER to Brandt Island -...	Hopper Dredge ENTRANCE to Nearshore...	Pipeline Dredge ENTRANCE to Beaches...	Hopper Dredge Outer Entrance to ODMDS MCACES...	Physical Monitoring and Surveys (3...	Planning, Engineering, & Design	Construction Management
Project Scope Growth	1	1	3	1	-	-	-
Acquisition Strategy	2	2	2	2	2	-	-
Construction Elements	1	1	1	1	-	-	-
Quantities for Current Scope	1	1	3	1	2	-	-
Specialty Fabrication or Equipment	-	-	-	-	-	-	-
Cost Estimate Assumptions	1	1	1	1	-	1	1
External Project Risks	3	3	3	3	-	2	2

APPENDIX H

EVALUATION OF SECTION 404(b)(1) (PUBLIC LAW 95-217) GUIDELINES 40 CFR 230

An evaluation of the placement of dredge and/or fill material into waters of the United States includes the standard form.

MOREHEAD CITY HARBOR DMMP
CARTERET COUNTY, NORTH CAROLINA

Preliminary Evaluation of Section 404 (b) (1) Guidelines 40 CFR 230

This evaluation covers the placement of all fill material into waters and wetlands of the United States required for the maintenance of the Morehead City Harbor, Carteret County, North Carolina. The proposed DMMP plans to place harbor maintenance sediment in the upland diked facility on Brandt Island (includes a return of effluent pipeline to the inner harbor), the ocean beaches and nearshore areas off Bogue and Shackleford Banks, and the US EPA approved ODMDS. Please note, prior to any construction the required Section 401 Water Quality Certificates from the NC Division of Water Quality will be obtained for the Morehead City Harbor DMMP and all conditions/restrictions will be complied with.

Section 404 Public Notice No. CESAW-TS-PE-

		Preliminary 1/	Final 2/
1.	Review of Compliance (230.10(a)-(d)) A review of the NEPA Document indicates that:		
a.	The discharge represents the least environmentally damaging practicable alternative and if in a special aquatic site, the activity associated with the discharge must have direct access or proximity to, or be located in the aquatic ecosystem to fulfill its basic purpose (if no, see section 2 and NEPA document);	YES ☒ NO☐	YES ☐ NO☐
b.	The activity does not: 1) violate applicable State water quality standards or effluent standards prohibited under Section 307 of the CWA; 2) jeopardize the existence of federally listed endangered or threatened species or their habitat; and 3) violate requirements of any federally designated marine sanctuary (if no, see section 2b and check responses from resource and water quality certifying agencies);	YES☒ NO☐*	YES☐ NO☐
c.	The activity will not cause or contribute to significant degradation of waters of the U.S. including adverse effects on human health, life stages of organisms dependent on the aquatic ecosystem, ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values (if no, see section 2);	YES☒ NO☐	YES☐ NO☐
d	Appropriate and practicable steps have been taken to minimize potential adverse		

impacts of the discharge on the aquatic ecosystem (if no, see section 5). YES☒ NO☐* YES☐ NO☐

Proceed to Section 2

*, 1, 2/ See page 6.

2. Technical Evaluation Factors (Subparts C-F) **N/A** **Not Significant** **Significant**

a. Physical and Chemical Characteristics of the Aquatic Ecosystem (Subpart C)

	N/A	Not Significant	Significant
(1) Substrate impacts.		X	
(2) Suspended particulates/turbidity impacts		X	
(3) Water column impacts.		X	
(4) Alteration of current patterns			
and water circulation.		X	
(5) Alteration of normal water			
fluctuations/hydroperiod.		X	
(6) Alteration of salinity gradients.	NA	X	

b. Biological Characteristics of the Aquatic Ecosystem (Subpart D)

	N/A	Not Significant	Significant
(1) Effect on threatened/endangered		X	
species and their habitat.		X	
(2) Effect on the aquatic food web.		X	
(3) Effect on other wildlife (mammals			
birds, reptiles, and amphibians).		X	

c Special Aquatic Sites (Subpart E)

	N/A	Not Significant	Significant
(1) Sanctuaries and refuges.	NA		
(2) Wetlands.	NA		
(3) Mud flats.	NA		
(4) Vegetated shallows.	NA		
(5) Coral reefs.	NA		
(6) Riffle and pool complexes.	NA		

d. Human Use Characteristics (Subpart F)

	N/A	Not Significant	Significant
(1) Effects on municipal and private water supplies.	NA		
(2) Recreational and commercial fisheries impacts		X	
(3) Effects on water-related recreation.		X	
(4) Aesthetic impacts.		X	
(5) Effects on parks, national and historical monuments, national seashores, wilderness areas,		X	
research sites, and similar preserves.		X	

Remarks: Where a check is placed under the significant category, preparer add explanation below.

Proceed to Section 3

*See page 6.

3. Evaluation of Dredged or Fill Material (Subpart G) 3/

a. The following information has been considered in evaluating the biological availability of possible contaminants in dredged or fill material. (Check only those appropriate.)

(1) Physical characteristics	☒
(2) Hydrography in relation to known or anticipated sources of contaminants	☒
(3) Results from previous testing of the material or similar material in the vicinity of the project	☒
(4) Known, significant sources of persistent pesticides from land runoff or percolation	☐
(5) Spill records for petroleum products or designated (Section 311 of CWA) hazardous substances	☐
(6) Other public records of significant introduction of contaminants from industries, municipalities, or other sources	☒
(7) Known existence of substantial material deposits of substances which could be released in harmful quantities to the aquatic environment by man-induced discharge activities	☐
(8) Other sources (specify).	☐

List appropriate references.

Reference: Draft Environmental Impact Statement, Morehead City Harbor DMMP, Carteret County, North Carolina, dated .

b. An evaluation of the appropriate information in 3a above indicates that there is reason to believe the proposed dredge or fill material is not a carrier of contaminants, or that levels of contaminants are substantively similar at extraction and disposal sites and not likely to result in degradation of the disposal site.** YES ☒ NO☐*

Proceed to Section 4

*, 3/, see page 6.

4. Disposal Site Determinations (230.11(f)).

a. The following factors as appropriate, have been considered in evaluating the disposal site.

(1) Depth of water at disposal site. ☒

(2) Current velocity, direction, and variability at disposal site ☒

(3) Degree of turbulence. ☒

(4) Water column stratification ☒

(5) Discharge vessel speed and direction ☒

(6) Rate of discharge ☒

(7) Dredged material characteristics (constituents, amount and type of material, settling velocities). ☒

(8) Number of discharges per unit of time. ☒

(9) Other factors affecting rates and patterns of mixing (specify)

List appropriate references.

Reference: .. Draft Environmental Impact Statement, Morehead City Harbor DMMP, Carteret County, North Carolina

b. An evaluation of the appropriate factors in 4a above indicates that the disposal site and/or size of mixing zone are acceptable. YES ☒ NO ☐*

5. Actions to Minimize Adverse Effects (Subpart H).

All appropriate and practicable steps have been taken, through application of recommendations of 230.70-230.77, to ensure minimal adverse effects of the proposed discharge. List actions taken. YES ☒ NO ☐*

See DEIS.

Return to section 1 for final stage of compliance review. See also note 3/, page 3.
*See page 6.

6. Factual Determinations (230.11).

A review of appropriate information as identified in items 2-5 above indicates that there is minimal potential for short- or long-term environmental effects of the proposed discharge as related to:

a. Physical substrate at the disposal site (review sections 2a, 3, 4, and 5). YES ☒ NO ☐*

b. Water circulation, fluctuation, and salinity (review sections 2a, 3, 4, and 5). YES ☒ NO ☐*

c. Suspended particulates/turbidity (review sections 2a, 3, 4, and 5). YES ☒ NO ☐*

d Contaminant availability (review sections 2a, 3, and 4). YES ☒ NO ☐*

e. Aquatic ecosystem structure and function (review sections 2b and c, 3, and 5). YES ☒ NO ☐*

f. Disposal site (review sections 2, 4, and 5). YES ☒ NO ☐*

g. Cumulative impact on the aquatic ecosystem. YES ☒ NO ☐*

h. Secondary impacts on the aquatic ecosystem. YES ☒ NO ☐*

7. Findings.

a.The proposed disposal site for discharge of dredged or fill material complies with the Section 404(b)(1) guidelines. . . . .☒

b.The proposed disposal site for discharge of dredged or fill material complies with the Section 404(b)(1) guidelines with the inclusion of the following conditions:. . . . .☐

c.The proposed disposal site for discharge of dredged or fill material does not comply with the Section 404(b)(1) guidelines for the following reasons(s):

(1)There is a less damaging practicable alternative . . . . ☐

(2)The proposed discharge will result in significant degradation of the aquatic ecosystem . . . .☐

*See page 6.

(3) The proposed discharge does not include all practicable and appropriate measures to minimize potential harm to the aquatic ecosystem. . . . . ☐

8.

____

Steven A. Baker
Colonel, U.S. Army
District Engineer

Date: ____________________

*A negative, significant, or unknown response indicates that the permit application may not be in compliance with the Section 404(b)(1) Guidelines.

1/ Negative responses to three or more of the compliance criteria at this stage indicate that the proposed projects may not be evaluated using this "short form procedure." Care should be used in assessing pertinent portions of the technical information of items 2 a-d, before completing the final review of compliance.

2/ Negative response to one of the compliance criteria at this stage indicates that the proposed project does not comply with the guidelines. If the economics of navigation and anchorage of Section 404(b)(2) are to be evaluated in the decision-making process, the "short form evaluation process is inappropriate."

3/ If the dredged or fill material cannot be excluded from individual testing, the "short-form" evaluation process is inappropriate.

APPENDIX I

ASSESSMENT OF POTENTIAL LARVAL ENTRAINMENT MORTALITY DUE TO HYDRAULIC DREDGING OF BEAUFORT INLET

Assessment of potential larval entrainment mortality due to hydraulic dredging of Beaufort Inlet

Lawrence R. Settle
NOAA/NOS
National Centers for Coastal Ocean Science
Center for Coastal Fisheries and Habitat Research
101 Pivers Island Road
Beaufort, NC 28516

The larval fish distribution, abundance, seasonality, transport and ingress at Beaufort Inlet has been extensively studied, particularly during the fall-winter period coinciding with the permitted dredging window (see references below). The concentration of fish larvae (all species combined) typically ranges from 0.5 to 5 larvae m^{-3}. The concentration (i.e. abundance) of larvae varies both spatially and temporally over a range of scales. It is therefore important to recognize that not all larvae in the inlet would be vulnerable to entrainment. Larvae are not equally distributed in the inlet as the flow has considerable asymmetry. During flood the bulk of the transport is on the eastern side of the inlet and most larvae enter on that side. Ebb flows containing larvae that were not retained in the estuary are strongest on the west side of the inlet. In addition, many larvae exhibit a vertical migration strategy that facilitates tidal stream transport. That is, larvae are up in the water column during flood and descend to near the bottom during ebb. Such behavior helps to prevent larvae from being flushed back out the inlet.

One can estimate the potential larval entrainment mortality due to hydraulic dredging of Beaufort Inlet using a simple mathematical model that incorporates the following:

C = concentration of larvae
= 0.5 to 5.0 larvae m^{-3}

M = proportion of larvae dying by natural causes every six hours
= 0.0125 (i.e. 5 % d^{-1}) to 0.025 (i.e. 10 % d^{-1})

V = volume of water entrained by dredge (24 h operation)
= 173,299 $m^3\ d^{-1}$ (USACE)

$\mathbf{P_s}$ = spring tidal prism
= 1.42 E8 m^3 (Jarrett, 1976)

$\mathbf{P_n}$ = neap tidal prism
= 1.32 E8 m^3 (Logan, 1995)

$\mathbf{P_b}$ = proportion of larvae in the bottom of the water column
= 0.1 to 1.0
$\mathbf{P_c}$ = proportion of larvae in the navigation channel
= 0.1 to 1.0

$\mathbf{P_r}$ = proportion of larvae retained inside to estuary during ebb phase
= 0.1 to 1.0

$\mathbf{E_s}$ = proportion of daily spring tidal volume entrained by dredge
= $V / 2\ P_s\ d^{-1}$
= 0.0006

E_n = proportion of daily neap tidal volume entrained by dredge
= $V / 2 P_n d^{-1}$
= 0.0007

L_s = initial number of larvae within a spring tidal prism
= $C * P_s$

L_n = initial number of larvae within a neap tidal prism
= $C * P_n$

K_{sf} = number of larvae entrained during a single spring tide flood phase
= $(L_s - (L_s * M * 2)) * P_b * P_c * E_s$

K_{se} = number of larvae entrained during a single spring tide ebb phase
= $(L_s - (L_s * M * 2) - K_{sf}) * P_b * P_c * P_r * E_s$

K_{nf} = number of larvae entrained during neap tide flood phase
=$(L_n - (L_n * M * 2)) * P_b * P_c * E_n$
K_{ne} = number of larvae entrained during neap tide ebb phase
= $(L_n - (L_n * M * 2)- K_{nf}) * P_b * P_c * P_r * E_n$

K_s = absolute larval entrainment mortality d^{-1} during spring tide
= $(K_{sf} + K_{se}) * 2$

Z_s = percent larval entrainment mortality d^{-1} during spring tide
= $(K_s/L_s*2)*100$

K_n = absolute larval entrainment mortality d^{-1} during neap tide
= $(K_{nf} + K_{ne}) * 2$
Z_n = percent larval entrainment mortality d^{-1} during neap tide
= $(K_n/L_n*2)*100$

Mortality due to entrainment was simulated 10,100 times for each level of natural mortality (i.e. 5% d^{-1} and 10% d^{-1}) during both spring and neap tidal conditions by systematically varying **C**, $\mathbf{P_b}$, $\mathbf{P_c}$, and $\mathbf{P_c}$ over the ranges outlined above using SAS Version 8.2 (SAS Institute Inc., Cary, NC). The results depicting the distribution of outcomes are shown below and include the minimum, maximum and mean impact levels as well as the 10%, 25%, 50% (median), 75% and 90% quantiles.

Natural mortality 10 % d^{-1} Natural mortality 5 % d^{-1}

	$\mathbf{K_s}$ No.	$\mathbf{Z_s}$ %	$\mathbf{K_n}$ No.	$\mathbf{Z_n}$ %	$\mathbf{K_s}$ No.	$\mathbf{Z_s}$ %	$\mathbf{K_n}$ No.	$\mathbf{Z_n}$ %
min	914	0.0006	991	0.0008	925	0.0007	1004	0.0008
max	1660902	0.1170	1801169	0.1365	1682195	0.1185	1824261	0.1382
mean	246426	0.0316	267246	0.0316	249585	0.0320	270672	0.0373
10 %	16282	0.0036	17658	0.0042	16490	0.0037	17884	0.0043
25 %	48845	0.0070	52973	0.0082	49471	0.0071	53651	0.0083
50 %	132906	0.0239	144136	0.0278	134610	0.0242	145984	0.0282
75 %	376763	0.0579	408595	0.0676	381594	0.0587	413833	0.0684
90 %	657882	0.0632	713472	0.0737	666316	0.0640	722619	0.0746

What is quite apparent is that both $\mathbf{Z_s}$ and $\mathbf{Z_n}$ (i.e. the percentage of the daily flux of larvae entrained) are very low regardless of larval concentration and the distribution of larvae within the channel. Under the worst-case scenario where the dredge operates 24 h d^{-1} , all larvae are in the navigation channel, on the bottom, and with poor retention in the estuary following flood stage, the maximum percentage entrained barely exceeds 0.1 % d^{-1} . Most of the simulated scenarios (see the 90 % quantiles) indicate the percent entrainment mortality to be less than 0.06 to 0.07 % d^{-1} with over half falling below 0.03 % d^{-1} (see 50 % quantile). The actual number of larvae entrained however, can range from as few as 914 up to over 1.8 million depending on the initial concentration of larvae within the tidal prism.
This simple analysis of the potential entrainment impacts to larvae could be further refined by stochastically varying the spatial and temporal concentration of larvae and their positions within the water column, but, based on the results presented here, such effort is not required to

achieve a useful first approximation of the level of impact to the resource. Because the estimated entrainment mortality, even under the worst-case scenario, is minimal (0.1 % d^{-1}), it seems reasonable to conclude that while any larvae that are entrained will certainly be killed, it is likely that the impact at the population-level would be insignificant.

References for larval fish distribution, abundance, seasonality, transport and ingress at Beaufort Inlet, North Carolina.

Blanton, J.O., J. Amft, R.A. Luettich, Jr., J.L. Hench and J.H. Churchill. 1999. Tidal and subtidal fluctuations in temperature, salinity and pressure for the winter 1996 larval ingress experiment - Beaufort Inlet, NC. Fish. Oceanogr. 8(Suppl. 2):134-152.

Burke, J.S., J.M. Miller and D.E. Hoss. 1991. Immigration and settlement pattern of *Paralichthys dentatus* and *P*. *lethostigma* in an estuarine nursery ground, North Carolina, U.S.A. Netherlands J. Sea Res. 27:393-405.

Churchill, J.H., J.O. Blanton, J.L. Hench, R.A. Luettich, Jr. and F.E. Werner. 1999. Flood tide circulation near Beaufort Inlet, North Carolina: implications for larval recruitment. Estuaries 22:1057-1070.

Churchill, J.H., R.B. Forward, R.A. Luettich, Jr., J.L. Hench, W.F. Hettler, Jr., L.B. Crowder and J.O. Blanton. 1999. Circulation and larval fish transport within a tidally dominated estuary. Fish. Oceanogr. 8(Suppl. 2):173-189.

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APPENDIX J

NMFS and USFWS
BIOLOGICAL ASSESSMENT (BA)
FOR
THREATENED AND ENDANGERED SPECIES

Morehead City Harbor
Draft Integrated DMMP and EIS,
Carteret County, North Carolina

BIOLOGICAL ASSESSMENT (BA)
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1.00 PROPOSED PROJECT

The proposed project is implementation of the proposed Dredged Material Management Plan for the Morehead City Harbor Federal Navigation Project. The proposed project is described in detail in the Morehead City Harbor Draft Integrated Dredged Material Management Plan (DMMP) and Environmental Impact Statement. Section 3.4.2 of the Draft Integrated DMMP and EIS fully describes the Proposed Action.

The U. S. Army Corps of Engineers (USACE), Wilmington District is responsible for the operation and maintenance of the federally-authorized Morehead City Harbor federal navigation channel. Engineering Regulation (ER) 1105-2-100 provides that a Dredged Material Management Plan (DMMP) be developed for federal navigation projects if a preliminary assessment does not indicate sufficient capacity to accommodate maintenance dredging for at least the next twenty years. The DMMP is a planning document that ensures that sufficient confined disposal facilities are available for at least the next 20 years and that maintenance dredging activities are performed in an environmentally acceptable manner, use sound engineering techniques, and are economically justified. The final product of this report will be an integrated DMMP and Environmental Impact Statement pursuant to the National Environmental Policy Act (NEPA). The DMMP addresses dredging needs, disposal capabilities, capacities of disposal areas, environmental compliance requirements, and potential for beneficial use of dredged material and indicators of continued economic justification. This DMMP will ensure sufficient disposal capacity for the 20-year period beginning in 2015 and extending through 2034. The EIS addresses the environmental impacts of implementing the DMMP.

The study area for the Morehead City Harbor DMMP includes the Morehead City Harbor navigation channels, the adjacent mainland area, the beaches of Bogue Banks and Shackleford Banks, the nearshore Atlantic Ocean off of Bogue Banks and Shackleford Banks, the Environmental Protection Agency (EPA) designated Morehead City Ocean Dredged Material Disposal Site (ODMDS), and the existing disposal sites of Brandt Island, Marsh Island and Radio Island.

The current Federal authorization for the Morehead City Harbor project consists of both deep draft and shallow draft channels. The deep draft portion of the project provides navigation channels from the deep water of the Atlantic Ocean to the North Carolina State Ports Authority (NCSPA) facilities. The shallow draft portion of the project provides for navigation channels from the waterfront docks at downtown Morehead City to the deep draft portion of the project. Dredging methods and disposal/placement options depend on the channel location and the *in situ* material characteristics. Based on these sediment characteristics and potential disposal locations, the deep draft channels or ranges are grouped into three sections; the Inner Harbor, the Outer Harbor, the Outer Entrance Channel.

The DMMP for the Morehead City Harbor project was developed using a consistent and logical procedure by which dredged material management measures have been identified, evaluated, screened, and recommended so that dredged material placement operations are conducted in a timely, environmentally sensitive, and cost-effective manner. Table J-1 summarizes the proposed DMMP.

DMMP Cycle	Harbor Section	Navigation Range Dredged	Dredge Plant	Proposed Disposal or Placement Location	Quantity Likely to be Dredged (cy)
Years 1, 4, 7, 10…	Outer	S. Range B, Cutoff, N. Range A to Sta. 110+00	30-inch pipeline	Fort Macon State Park/Atlantic Beach & Shackleford Banks	1,200,000
Years 2, 5,8,11…	Outer	S. Range C-N. Range B	hopper	Nearshore West & East	346,000
	Outer	S. Range B, Cutoff, N. Range A to Sta. 117+00	hopper	Nearshore West & East	650,000
Years 3,6,9,12…	Inner	Northwest Leg, West Leg 1 & East Leg	18-inch pipeline	Brandt Island or ODMDS (Bucket & Barge)	362,000
	Inner	West Leg 2 & N. Range C	18-inch pipeline	Brandt Island or ODMDS (Bucket & Barge)	152,000
	Outer	S. Range B, Cutoff, N. Range A to Sta. 117+00	hopper	Nearshore West & East	810,000
	Outer Entrance Channel	S. Range A, Sta. 117+00 out	hopper	ODMDS	344,000

Table J-1. Summary of the proposed Morehead City Harbor DMMP

Approximately 1 million cubic yards of dredged material are removed from the Morehead City Harbor annually. Current maintenance disposal practices, without modification, result in the need for “new” or expanded disposal sites or modified disposal options, including beneficial uses, by 2028. The proposed DMMP provides virtually unlimited disposal capacity for the Morehead City Harbor navigation project by recommending the following: continued use of Brandt

Island without expansion, disposal of coarse-grained material on the beaches of Fort Macon State Park, Atlantic Beach, and Shackleford Banks, expansion of the Nearshore West placement area, a new Nearshore East placement area and continued use of the EPA designated ODMDS. The proposed DMMP will provide more than adequate disposal capacity to maintain the Morehead City Harbor navigation project to the fully authorized dimensions for at least the next 20 years.

Beach disposal Alternatives on Bogue Banks and Shackleford Banks. Recommendations for future beach disposal operations along Bogue Banks are based on the volumetric losses within the area of Atlantic Beach and Fort Macon. It is recommended that future beach disposal operations place material primarily between Fort Macon and the town limits of Atlantic Beach as the base location. The quantity and location of future placements should be sufficient to ameliorate losses that have occurred between beach disposal operations and would be based on changes observed through the monitoring program. Figure J-1 displays the potential area designated for disposal of beach quality sand on Shackleford Banks.

The DMMP includes disposal of place suitable dredged sediment on approximately 3.65 miles of beach on Shackleford Banks (see Figure J-1). The area of possible impact on the Shackleford beach is from about the toe of the existing dune to the -24 foot depth of closure. The existing frontal dune on Shackleford Banks will not be impacted. The sediment placed below or waterward of the base of the existing frontal dune may range in height from about 6 feet NAVD and up to approximately 150 foot wide within the Shackleford Banks disposal area. Figure 4-2 in the DMMP/EIS shows the typical beach cross section of the proposed sediment berm in relationship to the existing frontal dune on Shackleford Banks.

For each dredge disposal occurrence (on average once every three years) on Shackleford Beach, only about a third to a half of the 3.65 mile disposal area on Shackelford Banks would be impacted with disposal of harbor sediment. After each beach disposal event (once every three years), the next occurrence would be located in another portion of the disposal area. The USACE, in coordination with the NPS would alternate disposal areas within the 3.65 mile long beach disposal area on Shackleford Banks so as not to impact the same disposal area time after time.

In several areas along the ocean beach strand from the spit to the start of the beach disposal location, there is no “dry” beach and the ocean waters come up to the base of the existing frontal dune during high tide. This means that in several areas, the mean high water (MHW) contour comes up to the base of the existing dune. The dredge contractor will not be allowed to impact the existing frontal dune along the ocean strand from the spit to the disposal area on Shackleford Banks. All beach equipment (dozers, pipeline sections, etc.) will be walked during low tide along the beach strand to the disposal site. This also means that no dredge pipeline from the dredge to the disposal area will be aligned along the ocean beach strand from the spit to the disposal area on Shackleford Banks. The end of the dredge pipeline will be submerged offshore from the dredge working in the harbor channels to the disposal site on Shackleford Banks. Once the end of the dredge pipeline emerges onshore within the sediment berm disposal site, the contractor will set up the dump shack, fencing, light stands and stockpile additional shore pipe within the constructed upland berm area (waterward of the existing frontal dune). Again the existing frontal dune will not be adversely impacted by the contractor's equipment on Shackleford Banks.

The NPS has the option to decline disposal of sand on Shackleford Banks during the life of the DMMP. Prior to any disposal activities on Shackleford Banks, a "Special Use Permit (SUP)" will be obtained from the NPS. The SUP will be obtained prior to start of construction and will contain conditions and restrictions that the contractor must meet. Before the contractor mobilizes their equipment to Shackleford Banks, the USACE, its contractor and the NPS will also meet to discuss all issues and decide on a work plan to ensure that there are no adverse impacts to Shackleford Banks.

Figure J-1. Proposed Shackleford Banks Beach disposal Area

2.00 PRIOR COORDINATION

Potential impacts on listed species have also been addressed previously for the project area. In May 2003, the USACE prepared a BA for the Morehead City Harbor Section 933 which authorized the disposal of maintenance dredged material from the existing Federal navigation channels onto the beaches of Bogue Banks from Fort Macon State Park to Indian Beach/Salter Path. The USFWS provided the USACE with a Biological Opinion (BO) dated July 22, 2003, which authorized the Section 933 project contingent on the USACE's compliance with all reasonable and prudent measures and the terms and conditions of the BO. NMFS indicated that additional consultation would not be required if the Section 933 project complied with the terms and conditions of the NMFS Regional Biological Opinion of September 27, 1997.

On 18 September 2008, the USACE provided NMFS with a revised Draft South Atlantic Regional Biological Assessment (SARBA). The USACE' SARBA would authorize the following activities: "*Dredging activities in the coastal waters, navigation channels (including designated Ocean Dredged Material Disposal Sites (ODMDS)), and sand mining areas in the South Atlantic Ocean from North Carolina/Virginia Border through and including Key West, Florida and the Islands of Puerto Rico and the U.S. Virgin Islands (USVI)*". Once NMFS provides the USACE with their Biological Opinion, any new conditions or restrictions would supersede the NMFS Biological Opinion dated September 25, 1997. Hopper dredging within the Morehead City Harbor would comply with any new conditions and/or restrictions found within the new NMFS BO.

The Finding of No Significant Impact (FONSI) for the Morehead City Interim Operations Plan (IOP) was approved on June 2009 (USACE 2009). The analysis of project impacts for the IOP resulted in a determination of "may affect, but not likely to adversely affect" threatened or endangered species as a result of implementation of the proposed project components. By letter dated April 13, 2009, the USFWS concurred with this determination, provided that reasonable and prudent measures and the terms and conditions of the July 22, 2003 Biological Opinion are met. By implementation of the Regional Biological Opinion of September 27, 1997 terms and conditions, for project implementation, by letter dated May 8, 2009 the NOAA, National Marine Fisheries Service found that additional consultation would not be required.

Dredging and disposal methods associated with the proposed action are similar to current maintenance dredging methods described in these previously coordinated documents.

3.0 SPECIES CONSIDERED UNDER THIS ASSESSMENT

Updated lists of threatened and endangered (T&E) species for the project area were obtained from NMFS (Southeast Regional Office, St. Petersburg, FL) and the

USFWS (Field Office, Raleigh, NC). These were combined to develop the following composite list in Table J-2, which includes T&E species that could be present in the area based upon their geographic range. However, the actual occurrence of a species in the area would depend upon the availability of suitable habitat, the season of the year relative to a species' temperature tolerance and migratory habits, and other factors.

Table J-2. Threatened and Endangered Species Potentially Present in Carteret County, NC

Species Common Names	Scientific Name	Federal Status
Vertebrates		
American alligator	*Alligator mississippiensis*	T(S/A)
Eastern cougar	*Felis concolor couguar*	Endangered*****
North Atlantic Right whale	*Eubaleana glacialis*	Endangered
Blue Whale	*Balaenoptera musculus*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered
Finback whale	*Balaenoptera physalus*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
Green sea turtle	*Chelonia mydas*	Threatened[1]
Hawksbill turtle	*Eretmochelys imbricata*	Endangered
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Loggerhead sea turtle	*Caretta caretta*	Threatened
West Indian Manatee	*Trichechus manatus*	Endangered
Piping Plover	*Charadrius melodus*	Threatened
Red-cockaded woodpecker	*Picoides borealis*	Endangered
Roseate tern	*Sterna dougallii*	Endangered
Red Knot	*Calidris canutus rufa*	Proposed Threatened
Smalltooth sawfish	Pristis pectinata	Endangered
Shortnose sturgeon	*Acipenser brevirostrum*	Endangered
Atlantic Sturgeon	*Acipenser oxyrhynchus oxyrhynchus*	Endangered
Invertebrates		
a skipper (butterfly)	*Atrytonopsis sp1*	FSC
Vascular Plants		
Rough-leaved loosestrife	*Lysimachia asperulaefolia*	Endangered
Seabeach amaranth	*Amaranthus pumilus*	Threatened

[1]Green turtles are listed as threatened, except for breeding populations in Florida and on the Pacific Coast of Mexico, which are listed as endangered.

Table J-2 KEY:

T(S/A) - Threatened due to similarity of appearance (e.g., American alligator)--a species that is threatened due to similarity of appearance with other rare species and is listed for its protection. These species are not biologically endangered or threatened and are not subject to Section 7 consultation.

Endangered - A taxon "in danger of extinction throughout all or a significant portion of its range."

Threatened - A taxon "likely to become endangered within the foreseeable future throughout all or a significant portion of its range."

FSC - A Federal species of concern--a species that may or may not be listed in the future (formerly C2 candidate species or species under consideration for listing for which there is insufficient information to support listing).

Species with 1 asterisk behind them indicate historic records:

* Historic record - the species was last observed in the county more than 50 years ago.

4.00 ASSESSMENT OF IMPACTS TO LISTED SPECIES

4.01 General Impacts

Dredging Equipment and Sediment Disposal Activities. Maintenance dredging and disposal of sediment from the existing Federal navigation channels in Morehead City Harbor has the potential to affect animals and plants in a variety of ways. The potential for adverse impacts may result from actions of the dredging equipment (i.e. suction, sediment removal, hydraulic pumping of water and sediment); physical contact with dredging equipment and vessels; physical barriers imposed by the presence of dredging equipment (i.e. pipelines); and disposal of dredged material (i.e. covering, suffocation) in the following areas:

1. Upland disposal area on Brandt Island,
2. USEPA designated Morehead City Ocean Dredged Material Disposal Site (ODMDS),
3. Nearshore areas off Bogue and Shackleford Banks, and
4. Atlantic Ocean beaches of Bogue Banks and Shackleford Banks.

Use of the existing disposal area on Brandt Island should not pose any adverse issues to the environment. Brandt Island is a 168-acre island, of which approximately 64 acres has been used as a disposal area since 1955. Return of effluent from Brandt Island is currently being discharged back into the inner harbor and can be controlled such that water released from the diked area has little or no suspended solids. Proper management of releases from Brandt Island will not increase turbidity levels in the area of the spillway pipe outfall above 25 NTUs.

The proposed DMMP will continue to use the USEPA designated Morehead City ODMDS. The dredged material proposed for ocean disposal has previously been evaluated for compliance with USEPA's Ocean Dumping Regulations and Criteria and are acceptable for transportation for ocean dumping under Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972, as amended. The USEPA, Region 4 has concurred with all previous Section 103 evaluations. Periodic re-evaluations will be performed as required by USEPA and USACE policy. Additionally, all disposal activities at the ODMDS must be conducted in accordance with the Site Management and Monitoring Plan (SMMP), dated February 2010 (USEPA and USACE 2010).

The DMMP proposes placement of dredged material in a new 492 acre Nearshore East placement area off Shackleford Banks and in the existing and expanded 1,050 acre Nearshore West placement area off Bogue Banks. Both nearshore placement areas are within the Beaufort Ebb Tide Delta and are about 1,000 to 2,000 feet offshore. The range in depth for the new Nearshore East is from about

-16 to -23 feet North American Vertical Datum (NAVD). The range in depth for the existing and expanded Nearshore West is from approximately -16 to -40 feet NAVD. Use of these placement areas may affect benthos. Covering of benthos and benthic habitat by discharged sediment represents a temporary resource loss since the discharge site will become a new area of benthic habitat and will be recolonized by benthic organisms. The ecological significance of temporary benthic losses is considered minor since the affected area is very small relative to the amount of benthic habitat present on the ocean bottom, the time span of loss is likely a period of months, and benthic populations in the vicinity are in a state of flux due to the dynamic sediment conditions in the area. Additionally, results of the recent survey of the new Nearshore East and the Nearshore West expansion area indicates that no hard bottoms are found in these areas.

Beach disposal of maintenance material and associated construction operations (i.e. operation of heavy equipment, pipeline route, etc.) on Bogue and Shackleford Banks, may adversely affect some species and their habitat, however the resultant constructed beach profile also promotes restoration of important habitat that has been lost or degraded as a result of erosion. Potential impacts vary according to the type of equipment used, the nature and location of sediment discharged, the time period in relation to life cycles of organisms that could be affected, and the nature of the interaction of a particular species with the dredging activities.

Noise. Within any harbor there are a number of noise sources. Ships arriving and departing (including tugs, etc.), recreational boats, dredges (cutterhead suction, mechanical, and hopper), and wharf/dock construction (pile driving, etc.), and natural (storms, biological, etc.) all make up the harbor ambient noise.

Noise in the outside environment associated with beach and nearshore placement activities would be expected to minimally exceed normal ambient noise in the project area; however, construction noise would be attenuated by background sounds from wind and surf. In-water noise would be expected in association with the dredging and the nearshore placement activities for this project. Specifically, noise associated with dredging could occur from (1) ship/machinery noise—noise associated with onboard machinery and propeller and thruster noise, (2) pump noise—noise associated with pump driving the suction through the pipe, (3) collection noise—noise associated with the operation and collection of material on the sea floor, (4) deposition noise—noise associated with the placement of the material within the barge or hopper, and (5) transport noise—noise associated with transport of material up the suction pipe. The limited available data indicate that dredging is not as noisy as seismic surveys, pile driving and sonar; but it is louder than most shipping, operating offshore wind turbines and drilling (Thomsen et al. 2009).

Dredging produces broadband and continuous, low-frequency sound (below 1 kHz) and estimated source sound pressure levels range between 168 and 186 dB reference (re) 1 µPa at 1 m, which can trigger avoidance reaction in marine mammals and marine fish. In some instances, physical auditory damage can occur. Auditory damage is the physical reduction in hearing sensitivity due to exposure to high-intensity sound and can be either temporary (temporary threshold shift) or permanent (permanent threshold Shift) depending on the exposure level and duration. Other than physical damage, the key auditory effect is the increase in background noise levels, such that the ability of an animal to detect a relevant sound signal is diminished, which is known as *auditory masking*. Masking marine mammal vocalizations used for finding prey, navigation and social cohesion could compromise the ecological fitness of populations (Compton et al. 2008).

According to Richardson et al. (1995) the following noise levels could be detrimental to marine mammals:

> Prolonged exposure of 140 dB re 1 µPa/m (continuous man-made noise), at 1 km can cause permanent hearing loss.
>
> Prolonged exposure of 195 to 225 dB re 1 µPa/m (intermittent noise), at a few meters or tens of meters, can cause immediate hearing damage.

According to Richardson et al. (1995), "Many marine mammals would avoid these noisy locations, although it is not certain that all would do so." In a study evaluating specific reaction of bowhead whales to underwater drilling and dredge noise, Richardson et al. (1990) also noted that bowhead whales often move away when exposed to drillship and dredge sound; however, the reactions are quite variable and can be dependent on habituation and sensitivity of individual animals. According to Richardson et al (1995), received noise levels diminish by about 60 dB between the noise source and a radius of 1 km. For marine mammals to be exposed to a received level of 140 dB at 1-km radius, the source level would have to be about 200 dB re 1 µPa/m. Furthermore, few human activities emit continuous sounds at source levels greater than or equal to 200 dB re 1 µPa/m; however, supertankers and icebreakers can exceed the 195 dB noise levels.

According to Clarke et al. (2002), hopper dredge operations had the highest sustained pressure levels of 120–140 dB among the three measured dredge types; however, the measurement was taken at 40 m from the operating vessel and would likely attenuate significantly with increased distance from the dredge. On the basis of (1) the predicted noise effect thresholds noted by Richardson et al. (1995), (2) the background noise that already exists in the marine environment, and (3) the ability of marine mammals to move away from the immediate noise source, noise generated by bucket, cutterhead, and hopper dredge activities would not be expected to affect the migration, nursing/breeding, feeding/sheltering or communication of large whales. Although behavioral effects are possible (i.e., a whale changing course to move away from a vessel), the number and frequency of vessels present in a given project area is would be small, and any behavioral impacts would be expected to be minor. Furthermore, for hopper dredging activities, endangered species observers would be on board and would record all large whale sightings and note any potential behavioral impacts. Per the standard USACE specifications for all dredging projects, the USACE and the contractor would keep the date, time, and approximate location of all marine mammal sightings. Care would be taken not to closely approach (within 300 ft.) any whales, manatees, or other marine mammals during dredging operations or transportation of dredged material. An observer would serve as a lookout to alert the dredge operator or vessel pilot or both of the occurrence of the animals. If any marine mammals are observed during other dredging operations, including vessel movements and transit to the dredged material disposal site, collisions must be avoided either through reduced vessel speed, course alteration, or both. During the evening hours, when there is limited visibility from fog, or when there are sea states of greater than Beaufort 3, the dredge must slow down to 5 knots or less when transiting between areas if whales have been spotted within 15 nautical miles of the vessel's path in the previous 24 hours. Sightings of whales or manatees (alive, injured, or dead) in the work area must be reported to NMFS Whale Stranding Network.

Similar to conclusions made regarding effects of sound on marine mammals, non-injurious impacts to sea turtles may also occur because of acoustic annoyance or discomfort. It has been hypothesized, on the basis of anatomical studies that sea turtle hearing range centers around low-frequency sounds. Ridgeway et al. (1969, 1970) evaluated the frequency sensitivity of green sea turtles and found that green turtles detect limited sound frequencies (200–700 Hz) and display high level of sensitivity at the low-tone region (approx 400 Hz). According to Bartol et al. (1999), the most sensitive threshold for loggerhead sea turtles is 250–750 Hz with the most sensitive threshold at 250 Hz. Though noise generated from dredging equipment is within the hearing range of sea turtles, no injurious effects would be expected because sea turtles can move from the area, and the significance of the noise generated by the dredging equipment dissipates with an increasing distance from the noise source.

Project Area. As mentioned above, the proposed project will occur in the following areas:

1. Morehead City Harbor (including Brandt Island), located at the confluence of the Newport River and Bogue Sound;
2. within the nearshore area off Bogue and Shackleford Banks;
3. along the ocean beaches of Shackleford and Bogue Banks (from Ft. Macon State Park up to Pine Knoll Shores) in Carteret County, and;
4. in the Atlantic Ocean.

Any potential impacts on threatened and endangered species would be limited to those species, which occur in habitats provided by these areas. Therefore, the proposed work will not affect any listed species, which generally reside in freshwater, forested upland habitats (long-leaf pine savannas), including the eastern cougar, American alligator, red-cockaded woodpecker, and rough-leafed loosestrife.

Species which could be present in the project area during the proposed action are the blue whale, finback whale, humpback whale, North Atlantic right whale (NARW), sei whale, sperm whale, West Indian manatee, piping plover, roseate tern, red knot, green sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, loggerhead sea turtle, Atlantic sturgeon, shortnose sturgeon, smalltooth sawfish, and sea-beach amaranth.

4.02 Species Accounts

4.02.1 Eastern Cougar, American Alligator, Red-cockaded woodpecker, Rough-leaved Loosestrife and a Rare Butterfly (*Atrytonopis* new species 1).

The Eastern Cougar, American Alligator, Red-cockaded woodpecker, and Rough-leaved Loosestrife are all terrestrial, freshwater, upland woodland species (including longleaf pine savannas). Since this habitat type is not present in the areas to be affected by the proposed action, these species are unlikely to occur.

A rare butterfly that is known only from Bogue Banks and adjoining islands may occur in the project area. This species rare butterfly (*Atrytonopsis* new species 1), is associated with the Dune Grass natural community and its larvae are believed to feed solely on seaside little bluestem (*Schizachryium littorale*), a common to dominant member of that community. Most of the known populations occur in naturally vegetated dune fields located behind the primary beaches along the ocean. Populations are also known from dredged material disposal islands that support seaside little bluestem, including Brandt Island. There have been no documented populations within the current diked area at Brandt Island, however, the species has been observed to the south of the slough dividing Brandt Island from the main portion of Bogue Banks (Personal Communication, Allison Leidner, September 2008). During the proposed 20-year study timeframe of the DMMP, the USACE is not planning to expand the Brandt Island upland diked disposal area. However, if the Brandt Island disposal area is expanded, the USACE will coordinate with representatives of the USFWS to ensure that no impacts to seaside little bluestem (*Schizachryium littorale*) occur.

Effect Determination. It has been determined that the proposed action is not likely to adversely affect any of these species or their habitat.

4.02.2 Roseate Tern

Roseate terns breed primarily on small offshore islands, rocks, cays, and islets. Rarely do they breed on large islands. They have been reported nesting near vegetation or jagged rock, on open sandy beaches, close to the waterline on narrow ledges of emerging rocks, or among coral rubble (USFWS 1999b). This species is primarily observed south of Cape Hatteras, particularly at Cape Point within Cape Hatteras National Seashore, during the months of July and August. According to John Fussell, (Personal Communication, 16 August 2010), roseate terns were collected in the 1930's in the Beaufort Inlet area and they are known to migrate north through the project area in mid to late May.

According to John Fussell (2010) roseate terns are rarely found in the project area. The only time they may be found in the project area is when they migrate north in mid to late May. The DMMP impact area for these species would be considered the ocean beaches and nearshore areas off Bogue and Shackleford Banks. The roseate tern may use the beaches of Bogue and Shackleford Banks for foraging and roosting habitat. However, disposal activities on both Bogue and Shackleford Banks will only occur ether during the hopper dredge window (January 1 to March 31 of any year) and/or the pipeline disposal windows (November 16 to April 30 for Bogue Banks and November 16 to March 31 for Shackleford Banks). Additionally, the physical work area on the ocean beaches would only impact a maximum of 200 feet a day. All work and equipment (i.e., shore pipe, dozers, personnel, etc.) would be off the ocean beaches by the end of the respective disposal windows. Disposal of coarse-gained sediment along the beaches of Bogue and Shackleford Banks will have no adverse effect on this species. A recent year round study in Brunswick County, NC documents observed shorebird use there (USACE 2003). This report indicated that disposal of beach compatible sediment on the beaches in Brunswick County had no measurable impact on bird use.

Effect Determination. On Bogue Banks there is also a large population of feral cats and raccoons that would adversely impact the nesting roseate tern. Additionally, the northern migration of the roseate tern may occur in mid to late May (Personal Communication, John Fussell, August 16, 2010). All beach disposal activities will be completed by April 30 (March 31 for Shackleford Banks) and all equipment (including personnel) will be off the beach strand by this date .

For these reasons it has been determined that the project may affect not likely to adversely affect this species.

4.02.3 Piping Plover

a. Status. Threatened

b. Occurrence in Immediate Project Vicinity

The Atlantic Coast piping plover population breeds on coastal beaches from Newfoundland to North Carolina (and occasionally in South Carolina) and winters along the Atlantic Coast (from North Carolina south), the Gulf Coast, and in the Caribbean where they spend a majority of their time foraging. Since being listed as threatened in 1986, only 800 pairs were known to exist in the three major populations combined and by 1995 the number of detected breeding pairs increased to 1,350. This population increase can most likely be attributed to increased survey efforts and implementation of recovery plans (Mitchell et. al. 2000).

Piping plovers are known to nest in low numbers in widely scattered localities on North Carolina's beaches. The species typically nests in sand depressions on unvegetated portions of the beach above the high tide line on sand flats at the ends of sand spits and barrier islands, gently sloping foredunes, blowout areas behind primary dunes, sparsely vegetated dunes, and washover areas cut into or between dunes. Piping plovers head to their breeding grounds in late March or early April (http://pipingplover.fws.gov/overview.html) and nesting usually begins in late April; however, nests have been found as late as July (Potter et al. 1980; Golder 1985). During a statewide survey conducted in 1988, 40 breeding pairs of piping plovers were located in North Carolina. LeGrand (1983) states that "all of the pipings in the state nest on natural beachfronts, both completely away from human habitation and [yet] in moderate proximity to man". The largest reported nesting concentration of the species in the State appears to be on Portsmouth Island where 19 nests were discovered in 1983 by John Fussell (LeGrand 1983). The southernmost nesting record for the state was one nest located in Sunset Beach by Phillip Crutchfield in 1983 (LeGrand 1983). Feeding areas include intertidal portions of ocean beaches, washover areas, mud flats, sand flats, wrack lines, and shorelines of coastal ponds, lagoons, or salt marshes (USFWS 1996a). Prey consist of worms, fly larvae, beetles, crustaceans, mollusks, and other invertebrates (Bent 1928).

The NC Wildlife Resources Commission database indicates that during the winter Piping Plovers were surveyed at Bear Island, Bogue Inlet Shoals, Dudley Island, and Emerald Isle, and the following numbers of wintering birds were observed: 1987–3, 1989–3, 1990–2, 1991–4, 1996–1, 1997–5, 1999–2, 2000–2, 2001–0, 2003–1, 2004–2, 2005–2, 2006–0, 2007–1 and 2008–0. More Piping Plovers were recorded during winter on Bear Island and Bogue Inlet Shoals were recorded rarely on Dudley Island. Ft. Macon survey area: 1991–0, 1996–1, 2001–0, 2006–1 (North Carolina Wildlife Resources Commission, Wildlife Diversity Program, unpublished data, accessed August 2010).

The Cape Lookout National Seashore, National Park Service in their annual Piping Plover Breeding Pairs at Cape Lookout National Seashore reports from 2001 to 2010 indicate that during this time only one pair of piping plovers nested on Shackleford Banks in 2005. This nest was located near milepost 49.8 on Shackleford Banks, which is close to Barden's Inlet and outside of the proposed 3.65 mile disposal area (see Figure J-1).

The piping plover is a fairly common winter resident along the beaches of North Carolina (Potter et al. 1980). On July 10, 2001, the USFWS designated 137 areas along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas as critical habitat for the wintering population of the piping plover where they spend up to 10 months of each year on the wintering grounds. Constituent elements for the piping plover wintering habitat are those habitat components that are essential for the primary biological needs of foraging, sheltering, and roosting, and only those areas containing these primary constituent elements within the designated boundaries are considered critical habitat. The USFWS has defined textual unit descriptions to designate areas within the critical habitat boundary. The USFWS has designated critical habitat for the Wintering Piping Plover (see Figure J-2) on Shackleford Banks off Beaufort Inlet (NC-9) and on Emerald Isle off Bogue Inlet (NC-10). Further discussion is found in Section D Project Impacts (2), below.

c. <u>Current Threats to Continued Use of the Area</u>. Loss and degradation of habitat due to development and shoreline stabilization have been major contributors to the decline of piping plovers. The current commercial, residential, and recreational development has decreased the amount of coastal habitat available for piping plovers to nest, roost, and feed. Specifically on Bogue Banks, nesting habitat continues to be degraded. Washover habitat that was created after Hurricane Fran in 1996 has since been developed with residential homes resulting in a continued decrease in nesting habitat availability. Additionally, nesting habitat along the western end of Bogue Banks, adjacent to Bogue Inlet, continues to be eroded away as result of the recent southwesterly shift of Bogue Inlet and the subsequent erosion towards the residential structures. Furthermore, long and short-term coastal erosion and the abundance of predators, including wild and domestic animals as well as feral cats, have further diminished the potential for successful nesting of this species. Since project beaches are wintering area for the piping plover, the major threat to its occupation of the area during the winter months would be continued degradation of beach foraging habitat. Similar degradation of beaches elsewhere could be a contributing element to declines in the state's nesting population.

d. <u>Project Impacts</u>.

(1). <u>Habitat</u>. The existing shorelines of Bogue Banks are heavily developed and are experiencing significant shoreline erosion. Piping plover breeding territories on the Atlantic Coast typically include a feeding area along expansive sand or mudflats in close proximity to a sandy beach that is slightly elevated and sparsely vegetated for roosting and nesting (http://www.fws.gov/raleigh/species/es_pipl.html). As erosion and development persist, piping plover breeding, nesting, roosting, and foraging habitat loss continues. Habitat loss from development and shoreline erosion and heavy public use has led to the degradation of piping plover habitat in the project area. The enhancement of beach habitat through the addition of beach fill may potentially restore lost roosting and nesting habitat; however, short-term impacts to foraging and roosting habitat may occur during project construction.

Beach compatible material will be placed along the beach strand of Fort Macon State Park, Town of Atlantic Beach, and if there is sufficient material (Section 3.4.2 Beach disposal) Pine Knoll Shores. Beach compatible material will be placed on Bogue Banks either by pipeline dredge from November 16 to April 30 or by using hopper dredges and will adhere to a January 1 to March 31 dredging window. Since piping plovers head to their breeding grounds in late March and nesting occurs in late April, beach disposal events will avoid impacts to breeding and nesting piping plovers to the maximum extent practicable. Additionally, the project construction limits do not extend into the USFWS designated critical habitat (paragraph 2, below) located across Beaufort Inlet on Shackleford Banks (see NC-8) and will therefore avoid this documented nesting habitat. However, wintering habitat for roosting and foraging may be impacted. Direct short-term foraging habitat losses will occur during construction of the project fill. Since only a small portion of the foraging habitat is directly affected at any point in time during pumpout and adjacent habitat is still available, overall direct loss of foraging habitat will be minimal and short-term. Additionally, disposal activities will be completed in three sections (i.e., Fort Macon State Park, Town of Atlantic Beach, and Pine Knoll Shores) at a rate of approximately 200 foot per day or 4-5,000 feet per month; therefore, un-impacted or recovered foraging habitat will be available throughout the disposal operation on Bogue Banks.

Every three years beach compatible material will also be placed along the 3.65 mile long beach strand of Shackleford Banks. The proposed 150 foot wide disposal berm would extend from the base of the existing frontal dune with potential impacts to the -24 foot depth of closure. Up to 33 acres (150 foot wide times 9,636 foot long divided by 43,560) of new ocean beach could be created every 3 years, east of the Shackleford spit off Beaufort Inlet. Beach compatible material will be placed on Shackleford Banks either by pipeline dredge from November 16 to March 31 or by hopper dredges and will adhere to a January 1 to March 31 dredging window. Since piping plovers head to their breeding grounds in late March and nesting occurs in late April, beach disposal events will avoid impacts to breeding and nesting piping plovers to the maximum extent practicable. Disposal activities will be completed in at a rate of approximately 200 feet per day or 4-5,000 feet per month; therefore, unimpacted or recovered foraging habitat will be available throughout the disposal operation on Shackleford Banks.

Direct short-term foraging habitat losses will occur during disposal of dredged material. Since only a small portion of the foraging habitat is directly affected at any point in time during sediment disposal activities and adjacent habitat is still available, overall direct loss of foraging habitat will be minimal and short-term.

(2) Designated Critical Habitat. The USFWS has designated critical habitat for the Wintering Piping Plover (see Figures J- 2 and J-3) on Shackleford Banks off Beaufort Inlet (NC-8) and on Emerald Isle off Bogue Inlet (NC-10). The USFWS has designated about 168 acres on Shackleford Banks as critical habitat for the Wintering Piping Plover (NC-8). Included within the designation of critical habitat are all land areas to the mean lower low water. However, USFWS has not designated critical habitat for the Wintering Piping Plover either within the existing Federal navigation channels (which range in depth from about -35 to -45 feet NGVD) or in the Atlantic Ocean placement areas (Bogue Banks beaches or the nearshore placement areas off Bogue Banks and Shackleford Banks). Water depths in the nearshore placement areas vary, but minimum depth is about -16 feet NGVD. The Nearshore Placement Areas are located about 1,000 to 2,000 feet offshore from Bogue and Shackleford Banks.

Placing beach compatible material within the proposed 3.65 mile beach disposal area on Shackleford Banks would benefit designated critical habitat for the Wintering Piping Plover by adding up to 33 acres of new ocean beach and intertidal area. Up to half of the 3.65 mile long disposal area would be impacted during any three year dredging cycle. The proposed 150 foot wide disposal berm would extend from the base of the existing frontal dune with potential impacts to the -24 foot depth of closure. As indicated in d(1) above, up to 33 acres (150 foot wide times 9,636 foot long divided by 43,560) of new ocean beach and habitat for the federally listed Wintering Piping Plover could be created every 3 years about 1 mile east of the Shackleford spit off Beaufort Inlet.

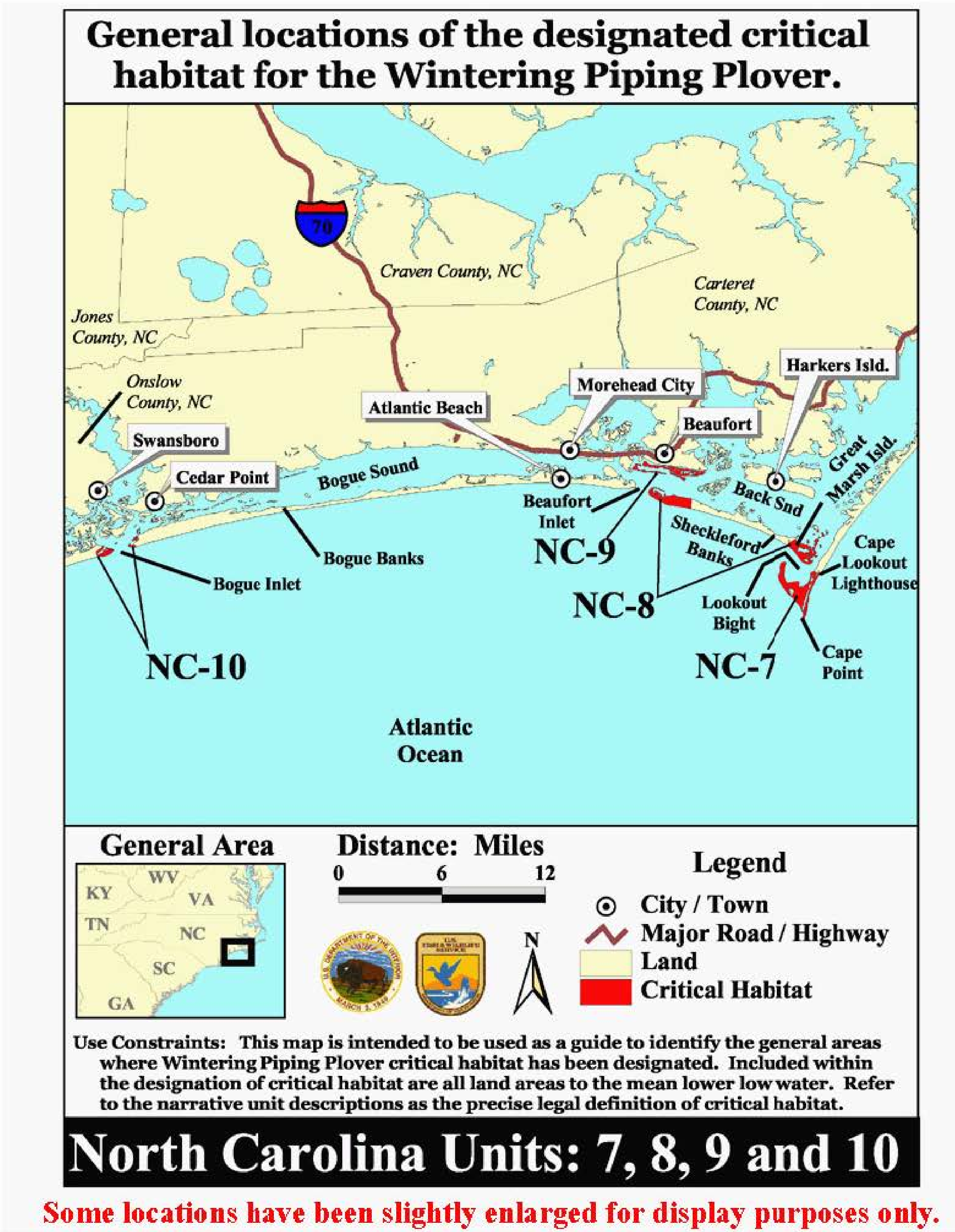

Figure J-2 USFWS General Locations of Designated Critical Habitat for Wintering Piping Plover

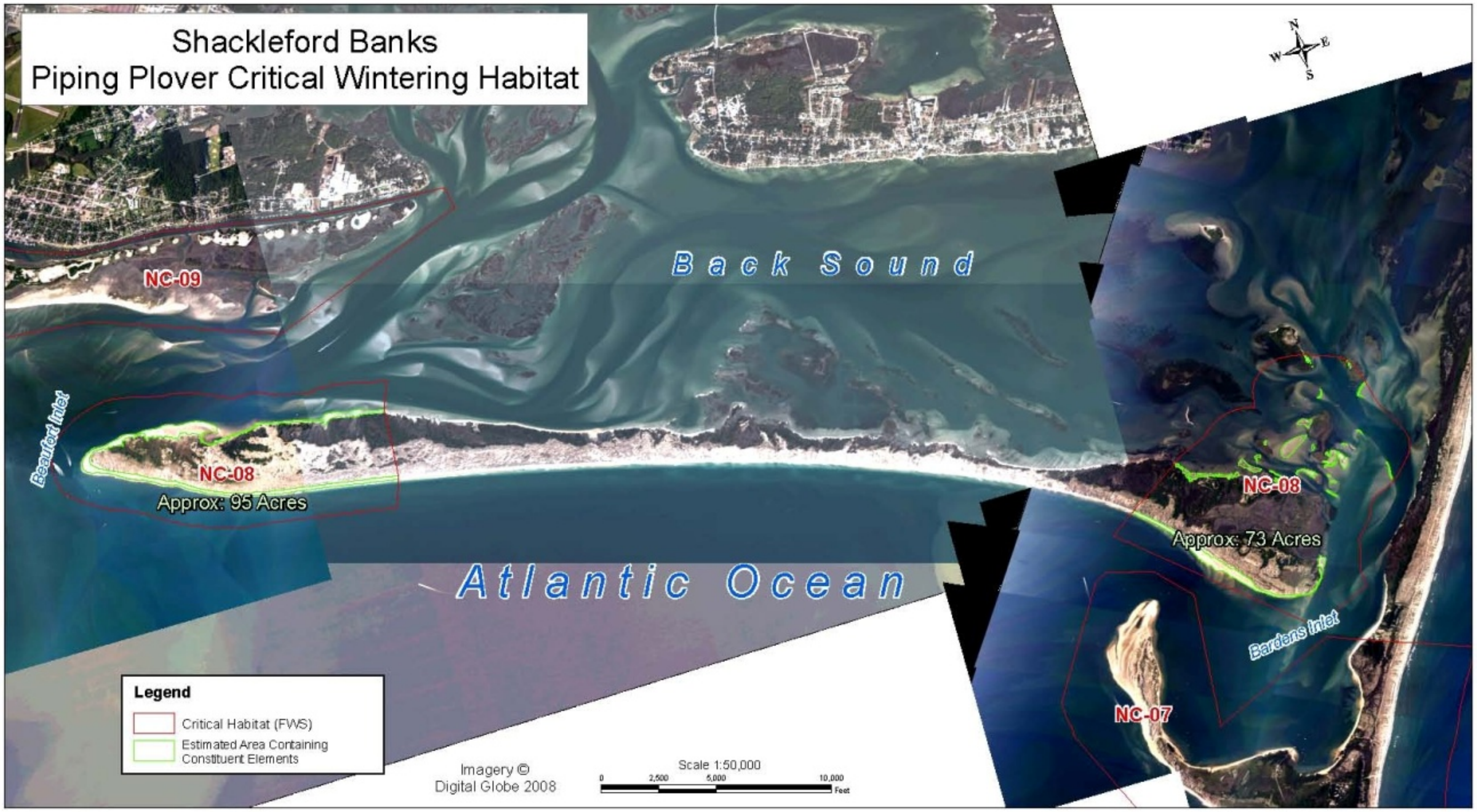

Figure J-3 USFWS Specific Locations of Designated Critical Habitat (NC-8) for Wintering Piping Plover on Shackleford Banks

Most piping plovers at Bogue Banks have been observed at the west end of Emerald Isle (which is outside of the proposed placement area) as predominantly a migratory and winter resident (Rice and Cameron 2008). When Bogue Inlet was relocated, the Town of Emerald Isle had the North Carolina Wildlife Resources Commission prepare a waterbird monitoring and management plan for the project area. The final report (Rice and Cameron 2008) states the following:

"The federally listed Piping Plover was observed along all four transects (i.e., Bear, Bogue, Dudley and the Inlet) throughout the length of the project and there has been an increase in the total number of observations in recent years (Table J-3, below). Counts of Piping Plovers initially decreased following the channel relocation, with the lowest number of observations (106) recorded in 2006. Numbers increased in 2007 (181) and again in 2008 (275). Most birds were observed along the Bear Island and Inlet transects. Birds were observed every month of the year with peak counts in September during pre-construction surveys and in March in years following construction. Bogue Inlet appears to be an important stop-over site during spring migration as birds return to their breeding grounds. It is also important for wintering plovers with between seven and eleven birds found wintering in any given year, representing approximately ten percent of the state's wintering population. The largest one day count during pre and post-construction surveys occurred in March of 2008 when 28 birds were observed on Bear Island. Piping Plover activity and habitat use is presented as percentages in Table J-3. In most years, the majority of birds were observed foraging with most observed using intertidal habitats".

Table J-3 Summary of total Piping Plover observations, 2003-2008. Taken from Rice and Cameron (2008).

	Total	Transect				% Habitat			% Activity			Peak Ct.
	Obs.	Bear	Bogue	Dudley	Inlet	Intertidal	Beach	Surf	Roosting	Foraging	Flying	(Month)
2003/04 (pre)	179	96	23	6	54	73.2	26.8	0.0	16.8	82.1	1.1	16 (Sept.)
2005 (during/post)	149	82	16	30	21	61.7	38.3	0.0	32.2	67.1	0.7	13 (Mar.)
2006 (post)	106	74	7	13	12	51.9	48.1	0.0	28.3	71.7	0.0	16 (Mar.)
2007 (post)	181	81	10	14	76	72.4	26.5	1.1	18.8	79.5	1.7	18 (Mar.)
2008 (post)	275	202	2	27	44	62.9	37.1	0.0	24.4	74.9	0.7	28 (Mar.)
Total	890	535	58	90	207	65.4	34.4	0.2	23.5	75.6	0.9	

However, Beaufort inlet also contains intertidal flats exposed at low tide that are prime feeding and roosting habitat for a variety of shorebirds and colonial waterbirds including pelicans, cormorants, terns, and gulls. These areas may be used by piping plovers as well. These shallow intertidal flats would not be adversely impacted by the continual maintenance dredging of the existing Federal navigation channels (which range in depth from about -35 to -45 feet NGVD) or the placement areas.

(3) Food Supply. Piping plovers feed along beaches and intertidal mud and sand flats. Primary prey includes polychaete worms, crustaceans, insects, and bivalves. According to Section 5 of the DMMP the benthic invertebrate community will suffer short-term impacts from the disposal of sediment on the beach; thus, a diminished prey base will subsequently impact piping plovers over the short term. However, only a portion of the beach is affected at any point in time (approximately 4-5,000 feet per month or up to 200 feet per day). Once construction passes that point, recruitment from adjacent beaches can begin. Therefore, unimpacted or recovering foraging habitat on Bogue and Shackleford Banks will be available throughout the duration of the project.

(4) Relationship to Critical Periods in Life Cycle. Beach disposal of sand derived from maintenance dredging of Morehead City Harbor is expected to occur only from November 16 to April 30 on Bogue Banks and November 16 to March 31 on Shackleford Banks (if a pipeline dredge is used) and from January 1 to March 31 (if a hopper dredge is used). Therefore, the breeding and nesting season will be avoided. However, foraging, sheltering, and roosting habitat may be temporarily impacted.

(5) Effect Determination. Short-term impacts of the proposed action on the piping plover would result from sediment placed within the 3.65 mile long area on Shackleford Banks. Coarse-grained sediment placed within the 3.65 mile long Shackleford Banks area (on average once every three years) would restore up to 33 acres of beach and intidal area for this species. Moreover all work on the ocean beaches of Shackleford Banks would not be instantaneous. Only a small portion of the beach would be impacted (up to 200 feet per day).

The long-term effects of the project may restore lost sheltering, feeding, roosting and nesting habitat through the addition of beach disposal activities within the 3.65 mile long disposal area on Shackleford Banks; however, short-term impacts (mentioned above) to foraging, feeding, sheltering, roosting habitat may occur during project construction. Therefore, it has been determined that the project may affect not likely to adversely affect the piping plover and is not likely to adversely modify USFWS designated wintering critical habitat.

4.02.4 Red Knot

a.) <u>Status</u> Federal – Proposed Threatened

b .) <u>Background</u>

The Red Knot (*Calidris canutus rufa)* is a medium-sized shorebird that undertakes an annual 30,000 km hemispheric migration, one of the longest among shorebirds. Their migration route extends from overwintering sites in the southernmost tip of South America at Tierra del Fuego, up the Eastern coast of the Americas through the Delaware Bay, and ultimately to breeding sites in the central Canadian Arctic. Red Knots break their migration into strategically timed and selected non-stop segments, of approximately 1,500 miles, throughout the entire Atlantic coast, including North Carolina. These staging areas consist of highly productive foraging locations which are repeatedly used year to year. As the Red Knot moves towards the northern extent of its migration route, the timing of departures becomes increasingly synchronized. One critical foraging stop for Red Knots occurs in the Delaware Bay where they feed almost exclusively on horseshoe crab eggs, due to their high fat content and ease of digestion, in order to reach threshold departure masses (180-200 grams) prior to heading for the Arctic breeding grounds. The arrival of the Red Knot in the Delaware Bay coincides with the spawning of the horseshoe crabs, which peaks in May and June. Birds arrive emaciated and can nearly double their mass (~4.6 grams/day) prior to departure if foraging conditions are favorable (Baker *et. al*., 2001), eating an estimated 18,000 fat-rich horseshoe crab eggs per day (Andres et al. 2003). This critical foraging stopover enables Red Knots to achieve the nutrient store levels necessary for migration, survival, and maximizing the reproductive potential of the population (Baker et. al. 2004). In order to increase their body mass at such a rapid rate during their refueling stopover in the Delaware Bay, Red Knots morph their guts during their migration route from South America to Delaware.

The Cape Lookout National Seashore, National Park Service (provided by Michael Rikard) in their annual 2006 to 2009 Red Knot Monitoring Reports at Cape Lookout National Seashore indicates the following:

<u>For Shackleford Banks</u>: In 2006, 9 birds were observed near Barden's Inlet, in 2007, 18 birds were observed between Beaufort and Barden's Inlets, in 2008, 96 birds were observed near Barden's Inlet, and in 2009, 18 birds were observed near Barden's Inlet.

Since 2006, a total of 141 red knots have been observed on Shackleford Banks (annual monitoring reports provided by Michael Rikard, NPS.).

Ms. Sara Schweitzer, North Carolina Wildlife Resources Commission, provided the following information (email dated 1 August 2011): *The data we have for Red Knots is from opportunistic counts of them, as well as counts of them during other surveys. There have not been surveys or studies on Red Knots specifically. Therefore, there may be more birds in NC than are indicated by our data.*

From the extant data, it appears that Red Knots are present in NC in greatest numbers (>100 per flock) during spring migration (April through May) during which time they may be in flocks up to 1000 birds.

Red Knots do feed extensively in the intertidal zone and on small coquina clams and horseshoe crab eggs. So they are either seen feeding voraciously or resting. Once they build up adequate fat reserves, they fly to their next stopover site. Some Red Knots have geo-locators on their leg bands and such data demonstrate that they can fly 100s of miles without stopping if they have adequate fat stores.

The best places for them to feed and rest are large intertidal areas for foraging, with foredunes in which to rest. No disturbance as these sites from pedestrians, dogs, or vehicles would be tolerated by the birds; thus, busy sites are not used. Our database indicates that sites with greatest numbers of Red Knots include:

Sunset Beach (northeast end and shoals in inlet) (private) Lea-Hutaff Island (Audubon) Masonboro Island (NERR) Topsail Beach, South end (private) Bald Head Island (foundation) Bear Island (State Park) Bogue Inlet shoals Bogue Sound-Bogue Inlet CLNS South Core Banks, North Core Banks, Shackleford Banks (NPS) New Drum Inlet shoals Clam Shoal CHNS Hatteras Island, South (NPS) CHNS, Ocracoke Island (NPS) Pea Island NWR -- N end Hatteras Island (USFWS & NPS)

Most areas where Red Knots occur in great numbers in spring migration are protected due to their ownership. However, there are areas with no protection from a conservation entity.

More recently, Niles *et. al.* (2009) reports continued shortage of horseshoe crab eggs at a critical stop in Delaware Bay for the Red Knot. Over the past 10 years, heavy commercial harvest of horseshoe crabs has caused a rapid decline in the crab's breeding population in Delaware Bay, reducing the number of eggs available to shorebirds. During this time the Red Knot population has declined from over 90,000 birds counted on Delaware Bay in 1989, to 32,000 in 2002. Similar declines have been shown in the South American wintering grounds suggesting that the viability of the Red Knot is seriously threatened. Demographic modeling predicts imminent endangerment and an increased risk of extinction without urgent management (Baker et al. 2004).

Morrison *et al*. (2004) have identified four factors that cause this vulnerability: (1) a tendency to concentrate in a limited number of locations during migration and on the wintering grounds, so that deleterious changes can affect a large proportion of the population at once; (2) a limited reproductive output, subject to vagaries of weather and predator cycles in the Arctic, which in conjunction with long lifespan suggests slow recovery from population declines; (3) a migration schedule closely timed to seasonally abundant food resources, such as horseshoe crab (*Limulus polyphemus*) eggs during spring migration in Delaware Bay, suggesting that there may be limited flexibility in migration routes or schedules; and (4) occupation and use of coastal wetland habitats that are affected by a wide variety of human activities and developments.

Considering the threat of extinction, petitions have been submitted to the United States Fish and Wildlife Service (USFWS) for emergency listing of the *rufa* subspecies of the Red Knot (*Calidris canutus rufa*) as endangered and to designate “critical habitat” under the Endangered Species Act (“ESA”). On September 12, 2006, the USFWS included the Red Knot as a candidate species that may warrant protection under the Endangered Species Act (ESA). On July 20, 2007, the Red Knot final status assessment report was made available in which the Service determined that the Red Knot warranted protection, but placing the bird on the endangered species list is precluded by higher priority listing actions for species at greater risk. Although the candidate species status does not provide any regulatory protection under ESA, the USFWS recommends that, given its candidate status, all Federal agencies funding, authorizing, or conducting actions that may affect the Red Knot or its habitat, including impacts to prey resources, give full consideration to the species in project planning.

On September 30, 2013, USFWS published in the Federal Register their proposal to list the red knot (*Calidris canutus rufa*) as Threatened species under the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531-1543).

c.) Project Impacts.

The disposal of sediment on the beach may have short-term impacts on benthic invertebrates. However, recovery occurs within 1-3 years depending on sediment compatibility and the frequency and size of disturbance (See Section 3.4.2 DMMP). Given their mobile foraging patterns, local disruptions to foraging habitat is likely not that disruptive to Red Knots (Harrington, Personal Communication, September 2006). Therefore, disruption from construction activities associated with beach disposal of sediment will likely result in the movement of Red Knots to an alternative foraging location. However, multiple or large scale disruptions effecting all key foraging locations at one time could have a profound impact. Though Red Knots can relocate with localized disruption, large scale disturbances that impact the entire range of foraging locations may be significant. Within the limits of foraging distribution, beach disposal activities should be constructed in a manner as to allow for unimpacted foraging habitat locations and avoid large scale disruption to benthic invertebrates to the maximum extent practicable. Additionally, beach placement on Shacklefored Banks will only take place from November 16 to March 31 of any year.

Roosting Red Knots prefer wide stretches of beach with limited disturbance. Contrary to their ability to tolerate disturbance while foraging and move among foraging habitats, Red Knots will avoid or abandon available roosting habitat adjacent to areas of disturbance. Furthermore, large scale development and continued beach erosion along the wintering and stopover range along the Atlantic has limited the availability of habitat that contains the necessary features for a suitable roosting environment. Beach disposal actions that occur within these limited roosting locations should avoid roosting time frames or implement appropriate buffer requirements during construction to the maximum extent practicable in order to minimize impacts. Beach disposal of sediment may have a beneficial effect on the Red Knot's roosting habitat in areas where significant erosion is occurring.

d.) Effect Determination. Short-term impacts of the proposed action on the Red Knot would result from the disposal of coarse-grained sediment within the 3.65 mile long Shackleford Banks area (on average once every three years). This activity would restore up to 33 acres of beach and intertidal area for this species. Moreover all work on the ocean beaches of Shackleford Banks would not be instantaneous. Only a small portion of the beach would be impacted (up to 200 feet per day. Additionally, beach placement on Shacklefored Banks will only take place from November 16 to March 31 of any year.).

The long-term effects of the project may restore lost sheltering, feeding, roosting and nesting habitat through the addition of beach disposal activities within the 3.65 mile long disposal area on Shackleford Banks; however, short-term impacts (mentioned above) to foraging, feeding, sheltering, and roosting habitat may occur during project construction.

Considering that construction activities will (1) avoid large scale disturbance within the limits of Red Knot foraging distribution and allow for areas of un-impacted or recovered foraging habitat within a given year, (2) avoid roosting timeframes or provide appropriate buffers around existing roosting habitat during construction operations, and (3) beach placement on Shackleford Banks will only take place from November 16 to March 31 once every three years, the disposal of sediment on the Bogue and Shackleford Banks beaches may affect not likely adversely affect the Red Knot.

4.02.5 West Indian Manatee

a. Status. Endangered.

b. Occurrence in Immediate Project Vicinity. The manatee is an occasional summer resident off the North Carolina coast with presumably low population numbers (Clark 1987). The species can be found in shallow (5 ft to usually <20 ft), slow-moving rivers, estuaries, saltwater bays, canals, and coastal areas (USFWS 1991). The West Indian manatee is herbivorous and eats aquatic plants such as hydrilla, eelgrass, and water lettuce (USFWS, 1999a). Manatees are thermally stressed at water temperatures below 18ºC (64.4ºF) (Garrot et al. 1995); therefore, during winter months, when ambient water temperatures approach 20ºC (68ºF), the U.S. manatee population confines itself to the coastal waters of the southern half of peninsular Florida and to springs and warm water outfalls as far north as southeast Georgia. During the summer months, sightings drop off rapidly north of Georgia (Lefebvre et al, *2001*) and are rare north of Cape Hatteras (Rathbun *et al, 1982*; Schwartz 1995). However, they are sighted infrequently in southeastern North Carolina with most records occurring in July, August, and September, as they migrate up and down the coast (Clark 1993). The Species is considered a seasonal inhabitant of North Carolina with most occurrences reported from

June through October (USFWS 2001). According to Schwartz (1995), manatees have been reported in the state during nine months, with most sightings in the August-September period. Manatee population trends are poorly understood, but deaths have increased steadily. A large percent of mortality is due to collisions with watercrafts, especially of calves. Another closely related factor in their decline has been the loss of suitable habitat through incompatible coastal development, particularly destruction of sea grass beds by boating facilities (USFWS 2001).

Manatees are rare visitors to Morehead City Harbor area. According to Schwartz (1995), a total of 68 manatee sightings have been recorded in 11 coastal counties of North Carolina during the years 1919-1994. Therefore, it is likely that manatees transit through the DMMP study area during the warm water months. Manatees are known to infrequently occur within nearly all North Carolina ocean and inland waters (Schwartz 1995) with four North Carolina records having been from inlet-ocean sites and six from the open ocean (Rathbun et al. 1982). According to the existing literature, specific numbers of manatees using the region are not known but are presumed to be very low. More research is needed to determine the status of the species in North Carolina and identify areas (containing food and freshwater supplies), which support summer populations.

c. Current Threats to Continued Use of the Area. Current threats to this species in the project area cannot be clearly assessed due to our lack of knowledge regarding its population, seasonality, distribution, and the habitat components in the project area that may be needed for its use. However, considering that manatees become thermally stressed at water temperatures below 18ºC (64ºF) (Garrot et al. 1995), cold winter temperatures keep the species from over wintering in the project area.

d. Project Impacts.

(1) Habitat. Impacts to estuarine and nearshore ocean habitat of the area associated with the disposal of sediment on the beach should be minor. With the current state of knowledge on the habitat requirements for the manatee in North Carolina, it is difficult to determine the magnitude of such impacts. Studies currently underway by the USFWS using animals fitted with satellite transmitters will hopefully provide data on the nature of these seasonal movements and habitat requirements during migrational periods.

(2) Noise. Section 4.01 General Impacts, describes the noise impacts on marine mammals.

(3) Food Supply. Foods, which are used by the manatee in North Carolina, are unknown. In Florida, their diet consists primarily of vascular plants. The proposed action will involve minimal change to the physical habitat of the estuary with no known impacts to vascular plants and overall estuarine and nearshore productivity

should remain high throughout the project area. Therefore, potential food sources for the manatee should be unaffected.

(4) Relationship to Critical Periods in Life Cycle. Since the manatee is considered to be an infrequent summer resident of the North Carolina coast, the proposed action should have little effect on the manatee since its habitat and food supply will not be significantly impacted. In regards to vessel collisions, the proposed maintenance dredging of the Morehead City Harbor federal navigation channels will occur in the estuarine or inlet habitat area and direct impacts from collision could take place. The USACE will implement precautionary measures for avoiding impacts to manatees from associated transiting vessels during construction activities, as detailed in the "Guidelines for Avoiding Impacts to the West Indian Manatee" established by the USFWS.

(5) Effect Determination. Since the habitat and food supply of the manatee will not be significantly impacted, overall occurrence of manatees in the project vicinity is infrequent, the maintenance dredging of the Federal navigation channels will occur in the estuarine or inlet habitat area and direct impacts from collision could take place, and precautionary measures for avoiding impacts to manatees, as established by USFWS, will be implemented for transiting vessels associated with the project, the proposed action may affect, not likely to adversely affect the manatee.

4.02.6 Blue Whale, Finback Whale, Humpback Whale, North Atlantic Right Whale (NARW), Sei Whale, and Sperm Whale

a. Status. Endangered

b. Occurrence in Immediate Project Vicinity. These whale species all occur infrequently in the ocean off the coast of North Carolina. Of these, only the NARW and the humpback whale routinely come close enough inshore to encounter the project area. Humpback whales were listed as "endangered" throughout their range on June 2, 1970 under the Endangered Species Act and are considered "depleted" under the Marine Mammal Protection Act. Humpbacks are often found in protected waters over shallow banks and shelf waters for breeding and feeding. They migrate toward the poles in summer and toward the tropics in winter and are in the vicinity of the North Carolina coast during seasonal migrations, especially between December and April. Since 1991, humpback whales have been seen in nearshore waters of North Carolina with peak abundance in January through March (NMFS 2003). In the Western North Atlantic, humpback feeding grounds encompass the eastern coast of the United States, the Gulf of St. Lawrence, Newfoundland/Labrador, and western Greenland. Major prey species include small schooling fishes (herring, sand lance, capelin, mackerel, small Pollock, and haddock) and large zooplankton, mainly krill (up to 1.5 tons per day) (http://www.nmfs.noaa.gov). Based on an increased number of sightings and stranding data, the Chesapeake and Delaware Bays and the U.S. mid-Atlantic and southeastern states, particularly along Virginia and North Carolina coasts, have become increasingly important habitat for juvenile humpback whales (Wiley et al. 1995).

There are 6 major habitats or congregation areas for the western NARW; these are the coastal waters of the southeastern United States, the Great South Channel, Georges Bank/Gulf of Maine, Cape Cod and Massachusetts Bays, the Bay of Fundy, and the Scotian Shelf. However, the frequency with which NARWs occur in offshore waters in the southeastern U.S. remains unclear (NMFS 2003). While it usually winters in the waters between Georgia and Florida, the NARW can, on occasion, be found in the waters off North Carolina. NARWs swim very close to the shoreline and are often noted only a few hundred meters offshore (Schmidly 1981). NARWs have been documented along the North Carolina coast, as close as 250 meters from the beach, between December and April with sightings being most common from mid to late March (Dr. Frank J. Schwartz, Personal Communication, January 19, 1996). Sighting data provided by the NARW Program of the New England Aquarium indicates that 93 percent of all North Carolina sightings between 1976 and 1992 occurred between mid-October and mid-April (Slay 1993). The occurrence of NARWs in the State's waters is usually associated with spring or fall migrations. Due to their occurrence in the nearshore waters, the transport of hopper dredges to and from the USEPA approved ODMDS could result in an encounter with humpback and NARW species.

c. Project Impacts.

(1) Habitat. No critical habitat has been designated for NARWs and humpback whales within the proposed project area.

(2) Noise. Section 4.01 General Impacts, describes the noise impacts on marine mammals.

(3) Food Supply. North Atlantic right whales feed primarily on copepods (*Calanus* sp.) and euphausids (krill) (NMFS 1991) and humpback whales feed on small fish and krill. The proposed DMMP will not diminish productivity of the nearshore ocean; therefore, the food supply of these species should be unaffected.

(4) Relationship to Critical Periods in Life Cycle.

North Atlantic Right Whale (NARW).

Detailed life history information for NARWs and potential effects from dredging activities area provided within the following Section 7 consultation documents:

National Marine Fisheries Service. 1997. Regional Biological Opinion for the Continued Hopper Dredging of Channels and Borrow Areas in the Southeastern United States. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Silver Spring, Maryland

USACE. September 2008. Regional Biological Assessment for Dredging Activities in the Coastal Waters, Navigation Channels (including designated Ocean Dredged

Material Disposal Sites (ODMDS)), and Sand Mining Areas in the South Atlantic Ocean. USACE, Wilmington District. Submitted to NMFS on 12 September 2008.

The referenced September 2008 Section 7 consultation document discusses in detail the June 26, 2006 proposed regulations by NMFS to implement mandatory vessel speed restrictions of 10 knots or less on vessels 65 ft. or greater in overall length in certain locations and at certain times of the year along the east coast of the U.S. Atlantic seaboard. Following the release of the referenced USACE consultation document, NMFS announced the release of the Final Rule and subsequent OMB approval of the collection-of-information requirements. Specifically, on October 10, 2008 NMFS published a final rule implementing speed restrictions to reduce the incidence and severity of ship collisions with North Atlantic right whales (73 FR 60173) with an effective date of December 9, 2008 through December 9, 2013. That final rule contained a collection-of-information requirement subject to the Paperwork reduction Act (PRA) that had not yet been approved by the Office of Management and Budget (OMB). Specifically, 50 CFR 224.105(c) requires a logbook entry to document that a deviation from the 10-knot speed limit was necessary for safe maneuverability under certain conditions. On October 30, 2008, OMB approved the collection-of-information requirements contained in the October 10, 2008, final rule. On December 5, 2008, NMFS announced that the collection-of-information requirements were approved under Control Number 0648–0580, with an expiration date of April 30, 2009 (15 CFR Part 902).

Humpback Whales.

The overall North Atlantic population of humpback whales is estimated at 10,600 individuals and is increasing (Waring et al. 1999); however the minimum population estimates for the Gulf of Maine stock is 647 individuals with a steadily increasing trend (NMFS 2003). For the period 1993-1997, the total estimated human-caused mortality and serious injury from fishery interactions and vessel collisions is estimated at 4.4 per year (NMFS 2003). According to Jensen and Silber’s (2003) large whale ship strike database, of the 292 records of confirmed or possible ship strikes to large whales, 44 records (15%) were of humpback whales, the second most often reported species next to finback whales (75 records) (26%). Of the 5 documented ship strikes resulting in serious injury or mortality for North Atlantic humpback whales from January 1997-December 2001, 3 where located in North Carolina and South Carolina waters. Though the total level of human-caused mortality and serious injury is unknown, current data indicate that it is significant; furthermore, mortality off the U.S. Mid-Atlantic States continues to increase (NMFS 2003).

(5) Effect Determination. Of the six species of whales being considered, only the NARW and humpback whale would normally be expected to occur within the project area during the project construction period. Therefore, the proposed project is not likely to adversely affect the blue whale, finback whale, sei whale, and sperm whale. Conditions outlined in previous consultations in order to reduce the potential for accidental collision (i.e. contractor pre-project briefings, large whale

observers, slow down and course alteration procedures, etc.) will be implemented as a component of this project. Based on the implementation of these conditions, dredging activities associated with the proposed project may affect not likely to adversely affect the NARW and humpback whale species.

4.02.7 Loggerhead, Hawksbill, Kemp's Ridley, Green, and Leatherback Sea Turtles

a. Status.

Loggerhead	*Caretta caretta*	Threatened
Hawksbill	*Eretmochelys imbricata*	Endangered
Kemp's Ridley	*Lepidochelys kempii*	Endangered
Green	*Chelonia mydas*	Threatened[1]
Leatherback	*Dermochelys coriacea*	Endangered

[1]Green turtles are listed as threatened, except for breeding populations in Florida and on the Pacific Coast of Mexico, which are listed as endangered.

b. Critical Habitat. Critical habitat has not been designated in the continental U.S. for the Hawksbill, Kemp's Ridley, Green, and Leatherback sea turtles identified to occur within the proposed project vicinity. Therefore, the proposed action would not result in an adverse modification to identified critical habitat for these four species. However, on March 25, 2013, the USFWS published in the Federal Register (50 CFR Part 17) their proposal to designate specific areas in the terrestrial environment as critical habitat for the Northwest Atlantic Ocean Distinct Population Segment of the threatened loggerhead sea turtle (*Caretta caretta*) under the Endangered Species Act (ESA) of 973, as amended (16 U.S.C. 1531–1543). The proposed critical habitat is located in coastal counties in North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi.

Within the proposed dredged material disposal areas for the Morehead City Harbor DMMP, the beaches of Bogue Banks have been designated in the proposed USFWS Critical Habitat Rule as the Northern Recovery Unit, North Carolina, LOGG-T-NC-01 (Bogue Banks in Carteret County) for the loggerhead sea turtle. This unit extends from Beaufort Inlet to Bogue Inlet and includes terrestrial lands from the Mean High Water (MHW) line landward to the toe of the secondary dune or developed structures.

Additionally, on July 18, 2013, the NMFS published in the Federal Register (50 CFR 226) their proposal to designate specific areas in the marine environment as critical habitat for the Atlantic Ocean loggerhead sea turtle Distinct Population Segment (DPS) (*Caretta caretta*) within the Atlantic Ocean under the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531–1543). In the Morehead City Harbor project area, NMFS is proposing to designate two unit descriptions for the loggerhead sea turtle: LOGG-N-2 – Southern Portion of the North Carolina Winter Concentration Area and LOGG-N-3 – Bogue Banks and Bear Island, Carteret and Onslow Counties, NC. The LOGG-N-2 unit is winter habitat only and includes waters from 20 meters (65.6 feet) to

100 meter (328 feet) depth contours. The LOGG-N-3 unit contains nearshore reproductive habitat only and consists of the nearshore ocean from Beaufort Inlet to Bogue Inlet and seaward 1.6 km (1 mile). This unit contains an area adjacent to high density nearshore reproductive habitat (Beaufort Inlet to Bogue Inlet) as well as an area of high density nearshore reproductive habitat (Bogue Inlet to Bear Inlet). Only the LOGG-N-3 unit would be applicable to the proposed Morehead City Harbor DMMP since all existing Federal navigation channels (i.e., Ranges A, B, and C, Cutoff and inner harbor channels) and disposal areas are in water depths less than 20 meters (65.6 feet).

Currently, both USFWS' and NMFS' proposals for designating critical habitat for the threatened loggerhead sea turtle have not been finalized. Moreover, the above mentioned unit descriptions for both USFWS and NMFS could change prior to the final critical habitat designations.

c. Background. Detailed life history information associated with the in-water life cycle requirements for sea turtles and a subsequent analysis of impacts from the proposed dredging activities is provided within the following NMFS Section 7 consultation documents:

National Marine Fisheries Service. 1997. Regional Biological Opinion for the Continued Hopper Dredging of Channels and Borrow Areas in the Southeastern United States. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Silver Spring, Maryland

USACE. September 2008. Regional Biological Assessment for Dredging Activities in the Coastal Waters, Navigation Channels (including designated Ocean Dredged Material Disposal Sites (ODMDS)), and Sand Mining Areas in the South Atlantic Ocean. USACE, Wilmington District. Submitted to NMFS on 12 September 2008

A summary of project specific information associated with beach and in-water habitat use is provided in the ensuing text.

1.) Occurrence in Immediate Project Vicinity. All five species of sea turtles identified above are known to occur in both the estuarine and oceanic waters of North Carolina. According to Epperly et al. (1994), inshore waters, such as Pamlico and Core Sounds, are important developmental and foraging habitats for loggerheads, greens, and Kemp's ridleys. Nearly all sea turtles found within these sounds are immature individuals immigrating into the sounds in the spring and emigrating from the sounds in the late fall and early winter (Epperly et al. 1995). Loggerhead, green, and Kemp's ridley sea turtles are known to frequently use coastal waters offshore of North Carolina as migratory travel corridors (Wynne 1999) and commonly occur at the edge of the continental shelf when they forage around coral reefs, artificial reefs, and boat wrecks.

Hawksbill and leatherback sea turtles infrequently enter inshore waters (Epperly et al, 1995) and are normally associated solely with oceanic waters (Schwartz 1977).

However, Lee and Palmer (1981) document that leatherbacks normally frequent the shallow shelf waters rather than those of the open sea, with the exception of long-range migrants.

Of the five species of sea turtles considered for this project, only the loggerhead sea turtle (*Caretta caretta*), the green sea turtle (*Chelonia mydas*), and the leatherback sea turtle (*Dermochelys coriacea*) nest regularly on North Carolina beaches and have the potential to nest within the project area. There are no documented nesting attempts of hawksbill and Kemp's ridley sea turtles on the project beaches; however, Kemp's ridley nests have been documented twice in North Carolina, once on Oak Island in 1992 and once on Cape Lookout in 2003 (Matthew Godfrey, Sea Turtle Program Coordinator, North Carolina Wildlife Resources Commission, Personal Communication, 2006). With a few exceptions, the entire Kemp's ridley population nests on the approximately 15 miles of beach in Mexico between the months of April and June (USFWS 1991). The hawksbill sea turtle nests primarily in tropical waters in south Florida and the Caribbean. Considering the infrequency of Kemp's ridley nesting occurrence throughout North Carolina and the lack of historical nesting of Kemp's ridley and hawksbill sea turtles on Bogue Banks, these species are not anticipated to nest within the project area. The loggerhead is considered to be a regular nester in the state, while green sea turtle nesting is infrequent and primarily limited to Florida's east coast (300 to 1,000 nests reported annually). According to Rabon et al. (2003), seven leatherback nests have been confirmed in North Carolina since 1998 constituting the northernmost nesting records for leatherbacks along the East Coast of the United States. Though almost all confirmed nesting activity in North Carolina has been between Cape Lookout and Cape Hatteras, the potential for leatherback nesting within the project area is likely.

Table J-4 shows the total number of recorded loggerhead, green, and leatherback sea turtle nests on Bogue Banks (includes Fort Macon State Park, Atlantic Beach, Pine Knoll Shores, Indian Beach/Salter Path, and Emerald Isle) beaches from 1997 to 2010. Both the Towns of Indian Beach/Salter Path and Emerald Isle are not within the DMMP DEIS project area. Though records were kept as early as 1997, consistent turtle nesting data has been recorded on Bogue Banks only since 2003. Furthermore, Standardized nest patrols were not enacted statewide until the mid 1990s; therefore, values from the first part of the 1990's to 2002 may not represent a full season of monitoring. Of the 412 nests laid within the Bogue Banks since 1997, loggerhead sea turtles laid 409 nests, 4 nests were laid by greens, and 2 nests were laid by leatherbacks (Matthew Godfrey, Personal Communication, 2010).

Table J-5, below shows the total number of recorded loggerhead, green, and leatherback sea turtle nests on Shackleford Banks between 2000 and 2009. Of the 144 nests laid on Shackleford banks since 2000, loggerhead sea turtles laid 142 nests, 1 nest was laid by a green, and 1 nest was laid by a leatherback. These numbers depicted in Table J-5 were taken from the Cape Lookout National Seashore annual sea turtle monitoring reports. All of these NPS annual reports were provided by Michael Rikard, the National Park Service, Cape Lookout National Seashore.

Year	Loggerhead (*Caretta caretta)*	Green (*Chelonia mydas*)	Leatherback (*Dermochelys coriacea)*
1997 *	33	0	0
1998 *	22	0	0
1999 *	35	0	0
2000 *	13	2	0
2001 *	21	0	0
2002 *	19	0	0
2003	38	0	0
2004	21	0	0
2005	33	1	2
2006	33	0	0
2007	27	0	0
2008	31	0	0
2009	34	1	0
2010 **	49	0	0
TOTALS	409	4	2

Table J-4. Total sea turtle nest numbers for Bogue banks from 1997-2010, which was provided by Matthew Godfrey, NC Wildlife Resources Commission. Loggerhead, green, and leatherback sea turtles are the only species with recorded nesting activity on Bogue Banks beaches.

* The entire Bogue Banks area was not monitored (i.e., incomplete numbers)
** Preliminary data for 2010 (as of 13 August 2010)

Year	Loggerhead (*Caretta caretta)*	Green (*Chelonia mydas*)	Leatherback (*Dermochelys coriacea)*
2000	16	0	0
2001	19	0	0
2002	10	1	0
2003	20	0	0
2004	10	0	0
2005	16	0	1
2006	14	0	0
2007	8	0	0
2008	18	0	0
2009	11	0	0
TOTALS	142	1	1

Table J-5. Total sea turtle nest numbers for Shackleford Banks from 2000-2009, which was provided by Jon NPS. Loggerhead, green, and leatherback sea turtles are the only species with recorded nesting activity on Shackleford Banks.

2.) Current Threats to Continued Use of the Area. In addition to affecting the coastal human population, coastal sediment loss also poses a threat to nesting sea turtles. A large percentage of sea turtles in the United States nest on nourished beaches (Nelson and Dickerson 1988a), therefore, nourishment has become an important technique for nesting beach restoration (Crain *et al.* 1995). The DMMP is not a nourishment project, however, beach disposal of coarse grained sediment from the navigation channel on the beaches of Bogue Banks and Shackleford Banks will function much like a nourishment project.
Since consistent turtle nesting surveys began on Bogue Banks in 2003, the average numbers of nests laid per year have remained largely constant with some minor fluctuations.

The primary threats facing these species worldwide are the same ones facing them in the project area. Of these threats, the most serious seem to be loss of breeding females through accidental drowning by shrimpers (Crouse et al*.* 1987) and human encroachment on traditional nesting beaches. Research has shown that the turtle populations have greatly declined in the last 20 years due to a loss of nesting habitat along the beachfront and by incidental drowning in shrimp trawl nets. It appears that the combination of poorly placed nests coupled with unrestrained human use of the beach by auto and foot traffic has impacted this species greatly. Other threats to these sea turtles include excessive natural predation in some areas and potential interactions with hopper dredges during the excavation of dredged material. With the exception of hopper dredges, none of the dredge plants (i.e., pipeline dredges or bucket and barge dredges) proposed for the maintenance of the existing navigation channel are known to take sea turtles.

d. Project Impacts.

In order to avoid periods of peak sea turtle abundance during warm water months and minimize impacts to sea turtles in the nearshore and offshore environment, the proposed hopper dredging window for this project is January 1 through 31 March. The pipeline dredging window with disposal on the adjacent beaches is from November 16 to April 30 on Bogue Banks and November 16 to March 31 on Shackleford Banks. By adhering to this dredging window to the maximum extent practicable, beach disposal will occur outside of the North Carolina sea turtle nesting season of May 1 through November 15. The limits of the nesting season window are based on the known nesting sea turtle species within the State and the earliest and latest documented nesting events for those species.

Considering that the proposed beach disposal windows for Bogue and Shackleford Banks will avoid the nesting season, direct impacts associated with construction activities during the nesting season are not anticipated and will be avoided to the maximum extent practicable.

Indirect impacts associated with changes to the nesting and incubating environment, from the disposal of sediment from alternate sources on the beach, are expected. The following section discusses both potential direct and indirect impacts to nesting sea turtles associated with the proposed project:

Section 4.01 General Impacts, describes the noise impacts on sea turtles.

(1) Beach disposal of Sediment Impacts.

Post-nourishment monitoring efforts have documented potential impacts on nesting loggerhead sea turtles for many years (Fletemeyer 1984; Raymond 1984; Nelson and Dickerson 1989; Ryder 1993; Bagley et al. 1994; Crain et al. 1995; Milton et al. 1997; Steinitz et al. 1998; Trindell et al. 1998; Davis et al. 1999; Ecological Associates, Inc. 1999; Herren 1999; Rumbold et al. 2001; Brock 2005). Results from these studies indicate that, in most cases, nesting success decreases during the year following nourishment as a result of escarpments obstructing beach accessibility, altered beach profiles, and increased compaction. A comprehensive post-nourishment study conducted by Ernest and Martin (1999) documented an increase in abandoned nest attempts on nourished beaches compared to control or pre-nourished beaches as well as a change in nest placement with subsequent increase in wash-out of nests during the beach equilibration process. Contrary to previous studies, this study suggests that a post-nourishment decline in nest success is more likely a result from changes in beach profile than an increase in beach compaction and escarpment formation. According to Brock (2005), the sediment used for the nourishment of Brevard County beaches in Florida offered little or no impediment to sea turtles attempting to excavate an egg chamber. Furthermore, the physical attributes of the nourished sediment did not facilitate excessive scarp formation and; therefore, turtles were not limited in their ability to nest across the full width of beach. However, a decrease in nest success was still documented in the year following nourishment with an increase in loggerhead nesting success rates during the second season post-nourishment. This was attributed to increased habitat availability following the equilibration process of the seaward crest of the berm. This study suggests that, if compatible sediment and innovative design methods are utilized to minimize post-nourishment impacts documented in previous studies, than the post-nourishment decrease in nest success without the presence of scarp formations, compaction, etc. may indicate an absence of abiotic and or biotic factors that cue the female to initiate nesting.

As suggested by the historical literature, there are inherent changes in beach characteristics as a result of mechanically placing sediment on a beach from alternate sources. The change in beach characteristics often results in short-term decreases in nest success and/or alterations in nesting processes. Based on the available literature, it appears that these impacts are, in many cases, site specific. Careful consideration must be placed on pre- and post-project site conditions and resultant beach characteristics after beach-fill episode at a given site in order to thoroughly understand identified post-project changes in nesting processes. By better understanding potential project specific impacts, modifications to project templates and design can be implemented to improve habitat suitability. The following sections review, more specifically, documented direct or indirect impacts to nesting females and hatchlings.

a. Pipe Placement.

Any sediment placed along the beaches will take place from November 16 to April 30 on Bogue Banks and November 16 to March 31 on Shackleford Banks. No work associated with beach disposal, including pipeline placement on the beach or in the water, staging of equipment on the beach, nor construction operations will take place outside of this window.

b. Slope and Escarpments.

The proposed beach disposals of dredged materials are designed and constructed to equilibrate to a more natural profile over time relative to the wave climate of a given area. Changes in beach slope as well as the development of steep escarpments may develop along the mean high water line as the constructed beach adjusts from a construction profile to a natural beach profile (Nelson et al. 1987). For the purposes of this assessment, escarpments are defined as a continuous line of cliffs or steep slopes facing in one general direction, which is caused by erosion or faulting. Depending on shoreline response to the wave climate and subsequent equilibration process for a given project, the slope both above and below mean high water may vary outside of the natural beach profile; thus resulting in potential escarpment formation. Though escarpment formation is a natural response to shoreline erosion, the escarpment formation as a result of the equilibration process during a short period following a beach disposal event may have a steeper and higher vertical face than natural escarpment formation and may slough off more rapidly landward.

Adult female turtles survey a nesting beach from the water before emerging to nest (Carr and Ogren 1960; Hendrickson 1982). Parameters considered important to beach selection include the geomorphology and dimensions of the beach (Mortimer 1982; Johannes and Rimmer 1984) and bathymetric features of the offshore approach (Hughes 1974; Mortimer 1982). Beach profile changes and subsequent escarpment formations may act as an impediment to a nesting female resulting in a false crawl or nesting females may choose marginal or unsuitable nesting areas either within the escarpment face or in front of the escarpment. Often times these nests are vulnerable to tidal inundation or collapse of the receding escarpment. If a female is capable of nesting landward of the escarpment prior to its formation, as the material continues to slough off and the beach profile approaches a more natural profile, there is a potential for an incubating nest to collapse or fallout during the equilibration process. Loggerheads preferentially nest on the part of the beach where the equilibration process takes place (Brock 2005; Ecological Associates, Inc. 1999) and are more vulnerable to fallout during equilibration. However, according to Brock (2005), the majority of green turtle nests are placed on the foredune and; therefore, the equilibration process of the beach disposal event substrate may not affect green turtles as severely.

A study conducted by Ernest and Martin (1999) documented increased abundance of nests located further from the toe of the dune on nourished vs. control beaches. Thus, post beach disposal event nests may be laid in high-risk areas where vulnerability to sloughing and equilibration are greatest. Though nest relocation is not encouraged, considering that immediately following beach disposal event the likelihood of beach profile equilibration and subsequent sloughing of escarpments as profile adjustment occurs, nest relocation may be used as a last alternative to move nests that are laid in locations along the beach that are vulnerable to fallout (i.e. near the mean high water line). As a beach disposal event beach is re-worked by natural processes and the construction profile approaches a more natural profile, the frequency of escarpment formation declines and the risk of nest loss due to sloughing of escarpments is reduced. According to Brock (2005), the return of loggerhead nesting success to equivalent rates similar to those on the adjacent non-nourished beach and historical rates two seasons post-nourishment were observed and are attributed to the equilibration process of the seaward crest of the berm.

Though the equilibration process and subsequent escarpment formation are features of most beach projects, management techniques can be implemented to reduce the impact of escarpment formations. For completed sections of beach during beach disposal events, and for subsequent years following as the construction profile approaches a more natural profile, visual surveys for escarpments could be performed. Escarpments that are identified prior to or during the nesting season that interfere with sea turtle nesting (exceed 18 inches in height for a distance of 100 ft.) can be leveled to the natural beach for a given area. If it is determined that escarpment leveling is required during the nesting or hatching season, leveling actions will be directed by the NCWRC and USFWS.

c. Incubation Environment.

Physical changes in sediment properties that result from the placement of sediment, from alternate sources, on the beach pose concerns for nesting sea turtles and subsequent nest success. Constructed beaches have had positive effects (Broadwell 1991; Ehrhart and Holloway-Adkins 2000; Ehrhart and Roberts 2001), negative effects (Ehrhart, 1995 Ecological Associates, Inc. 1998), or no apparent effect (Raymond 1984.; Nelson et al. 1987; Broadwell 1991; Ryder 1993; Steinitz et. al. 1998; Herren 1999) on the hatching success of marine turtle eggs. Differences in these findings are related to the differences in the physical attributes of each project, the extent of erosion on the pre-existing beach, and application technique (Brock 2005).

If nesting occurs in new sediment following beach construction activities, embryonic development within the nest cavity can be affected by insufficient oxygen diffusion and variability in moisture content levels within the egg clutch (Ackerman 1980; Mortimer 1990; Ackerman *et al*. 1992); thus, potentially resulting in decreased hatchling success.

Ambient nest temperature and incubation time are affected by changes in sediment color, sediment grain size, and sediment shape as a result of beach nourishment (Milton *et al.* 1997) and; thus, affect incubation duration (Nelson and Dickerson 1988a). Sexual differentiation in chelonians depends on the temperature prevailing during the critical incubation period of the eggs (Pieau 1971; Yntema 1976; Yntema and Mrosovsky 1982; Bull and Vogt 1979), which occurs during the middle third of the incubation period (Yntema 1979; Bull and Vogt 1981; Pieau and Dorizzi 1981; Yntema and Mrosovsky 1982; Ferguson and Joanen 1983; Bull 1987; Webb et al. 1987; Deeming and Ferguson 1989; Wibbels *et al*. 1991), and possibly during a relatively short period of time in the second half of the middle trimester (Webster and Gouviea 1988). Eggs incubated at constant temperatures of 28°C or below develop into males. Those kept at 32°C or above develop into females. Therefore, the pivotal temperature, those giving approximately equal numbers of males and females, is approximately 30°C (Yntema and Mrosovsky 1982). Estimated pivotal temperatures for loggerhead sea turtles nesting in North Carolina, Georgia, and southern Florida are close to 29.2°C (Mrosovsky and Provancha 1989). Therefore, fluctuation in ambient nest temperature on constructed beaches could directly impact sex determination if nourished sediment differs significantly from that found on the natural beach. Since, the pivotal temperatures for the northern and southern geographic nesting ranges of loggerheads in the United States are similar, a higher percentage of males are produced on North Carolina beaches and a higher percentage of females on Florida beaches. Hatchling sex ratios are of conservational significance (Mrosovsky and Yntema 1980; Morreale *et al*. 1982) since they may affect the population sex ratio and thus could alter reproductive success in a population (Herren et al. 1999).

d. <u>Nest Relocation</u>.

Relocation of sea turtle nests to less vulnerable sites was once common practice throughout the southeastern U.S. to mitigate the effects of natural or human induced factors. However, the movement of eggs creates opportunities for adverse impacts. Therefore, more recent USFWS guidelines are to be far less manipulative with nests and hatchlings to the maximum extent practicable. Though not encouraged, nest relocation is still used as a management technique of last resort where issues that prompt nest relocation cannot be resolved. Potential adverse impacts associated with nest relocation include: survey error (Shroeder 1994), handling mortality (Limpus et al. 1979; Parmenter 1980), incubation environment impacts (Limpus *et al*. 1979; Ackerman 1980; Parmenter 1980; Spotila et al. 1983; McGehee 1990), hatching and emergence success, and nest concentration.

Beach disposal event efforts associated with this project are scheduled, to work outside of the sea turtle nesting season in order to avoid impacts to nesting females and the nest incubation environment. Therefore, we are not proposing to relocate any sea turtle nests in the project area.

e. <u>Beach Compaction and Hardness</u>.

Sediment placed on the beach, as a component of shoreline protection projects, beach disposal, sand-bypassing, etc. is often obtained from three main sources: inlets, channels, or offshore borrow sites (Crain et al. 1995) with occasional use of upland sources. Significant alterations in beach substrate properties may occur with the input of sediment types from other sources. Sediment density (compaction), shear resistance (hardness), sediment moisture content, beach slope, sediment color, sediment grain size, sediment grain shape, and sediment grain mineral content can be changed by beach nourishment.

Current sea turtle literature has attributed post-nourishment beach hardness to sand compaction but it should be more appropriately attributed to sediment shear resistance. Increased shear resistance can be due to increased sand compaction (density), but it can also be due to other factors such as sand particle characteristics (size, shape) and interactions between the particles (Spangler and Handy 1982;Nelson et al. 1987; Nelson and Dickerson 1989; Ackerman 1996). Shear resistance describes the ability of the beach sand to resist sliding along internal surfaces. A measure of shear resistance can be described as a measure of beach hardening or strength. The sand particle surface characteristics contribute to the sliding friction ability of the sand particles. Various parameters (chemical composition, cohesion, moisture content, sediment layering and mixing) contribute to the interlocking ability of the sand particles. Sliding friction, interlocking, and compaction of the sand particles all contribute to a measure of shear resistance. Thus, a measurement of increased shear resistance does not necessarily mean that the beach is also compacted (Ackerman 1996).

Factors which may contribute to increased beach hardness (shear resistance) on nourished beaches include a high silt component, angular fine-grained sand, higher moisture content, equipment and vehicular traffic, and hydraulic slurry deposition of sediments (Nelson 1985; Nelson et al, 1987; Nelson and Dickerson 1988a; 1989; Ackerman 1996). Beach fill can vary in amount of carbonate sand, quartz sand, shell, coral, silt, and clay content (National Research Council 1995). Sediments used for beach fill with clay or silt contents higher than 5-10% may cause high beach hardness once the sediment dries (Nelson 1985; Dean 1988). Harder nourished beaches typically result from angular, finer grain sand dredged from stable offshore borrow sites; whereas, less hard or “softer” beaches result from smoother, coarse sand dredged from high energy locations (e.g. inlets) (Spangler and Handy 1982; Nelson et al*,* 1987; Nelson and Dickerson 1988a; 1989). Nourished beaches may result in sediment moisture content more than 4% higher than adjacent, natural beaches (Ackerman 1996, Ackerman et al*.* 1992). Placement of fill material with heavy equipment imparts a component of “compactness” that should not occur on natural beaches. The natural process of beach formation, over an extended period of time, results in extensive sorting of the sand both by layers and within layers. Layer orientation is determined by the wave wash which is not the same for nourished beaches (National Research Council 1995).

Hard sediment can prevent a female from digging a nest or result in a poorly constructed nest cavity. Females may respond to harder physical properties of the beach by spending more time on the beach nesting, which may result in physiological stress and increased exposure to disturbances and predation; thus, in some cases leading to a false dig (Nelson and Dickerson 1989). Although increased shear resistance does not occur with every nourishment project, higher shear resistance measurement values have been more frequently reported over the past 30 years from nourished beaches than on natural beaches of the same area (e.g. Mann 1977; Fletemeyer 1983; Raymond 1984; Nelson et al. 1987; Moulding and Nelson 1988; Nelson and Dickerson 1988a; Ryder 1995; Bagley et al. 1994; Crain et al. 1995; Ernest et al. 1995; Foote and Truitt 1997; Milton et al. 1997; Steinitz et al. 1998; Trindell et al. 1998; Davis et al. 1999; Herren 1999; Allman et al. 2001; Rumbold et al. 2001; Piatkowski 2002; Scianna et al. 2001; Brock, 2005). Results have varied tremendously on the nesting success reported in these studies when comparing nourished and natural beaches of different shear resistance values. The natural variance in shear resistance values and the nesting success related to these values is still poorly understood. Due to the many variables involved from natural and non-natural causes, it is extremely difficult to identify impacts from nourishment projects by only evaluating nesting success data. Analyses of shear resistance values and nesting success have yet to determine a consistent relationship (Trindell et al. 1998). It is difficult to define absolute or optimal shear resistance values until these relationships are better understood throughout the sea turtle nesting range in the United States (Gulf and South Atlantic states). Crain et al. (1995) also recommended this as a research priority for beach nourishment impact studies.

Measuring shear resistance has become a common procedure of most beach nourishment projects and is usually done with a hand-held cone-penetrometer (Crain et al 1995). While holding the instrument in a vertical orientation, measurements are obtained by manually pushing it into the beach sediment. Based on data collected during the 1980's from nourished and non-nourished projects on the Atlantic coast of Florida, the USACE provided initial guidelines on maximum cone-penetrometer values (600) below which might be more compatible with natural nesting beaches (Nelson et al. 1987; Moulding and Nelson 1988; Nelson et al. 1987; Nelson and Dickerson 1988a; 1989). The USFWS later adopted these guidelines into permitting regulations for all nourished projects along the U.S. Atlantic and Gulf of Mexico coasts with potential sea turtle nesting habitat. These requirements are still in effect to date and are outlined in state construction permit requirements and Biological Opinions issued by USFWS dated 22 July 2003. According to the general USFWS compaction measurement guidelines for NC outlined below, compaction measurements of 500 PSI establishes the level of beach hardness when post-nourishment beach tilling should be done to reduce the shear resistance measurements.

General USFWS Compaction Guidelines

1. Compaction sampling stations will be located at 500-foot intervals along the project area. One station will be at the seaward edge of the dune line (when material is placed in this area); and one station must be midway between the dune line and the high water line (normal wrack line).

At each station, the cone penetrometer will be pushed to a depth of 6, 12, and 18 inches three times (three replicates). Material may be removed from the hole if necessary to ensure accurate readings of successive levels of sediment. Layers of highly compact material may lie over less compact layers. Replicates will be located as close to each other as possible, without interacting with the previous hole and/or disturbed sediments. The three replicate compaction values for each depth will be averaged to produce final values for each depth at each station. Reports will include 18 values for each transect line, and the final 6 averaged compaction values.

2. If the average value for any depth exceeds 500 pounds per square inch (psi) for any two or more adjacent stations, then that area must be tilled prior to May 1. If values exceeding 500 psi are distributed throughout the project area, but in no case do those values exist at two adjacent stations at the same depth, then consultation with the Fish and Wildlife Service will be required to determine if tilling is required. If a few values exceeding 500 psi are randomly present within the project area, tilling will not be required. For all circumstances where tilling is implemented, the designated area shall be tilled to a depth of 36 inches. Tilling will be performed (i.e. overlapping rows, parallel and perpendicular rows, etc.) so that all portions of the beach are tilled and no furrows are left behind All tilling activities must be completed prior to May 1 in accordance with the following protocol.

Readings of cone index values can be roughly equated to pounds per square inch (psi). However, this is a relative value and caution should be used when attempting to compare cone index values in pounds per square inch to other sources of data (Moulding and Nelson 1988). Ferrel et al. (2002) and Piatkowski (2002) used a Lang penetrometer, as opposed to the cone-penetrometer, because readings are not influenced by the mass of the user. This is an issue when multiple people of varying mass and strength are conducting the measurements. Much of the variation in the compaction data could be due to variability inherent in the use of the cone-penetrometer itself. Ferrell *et al.* (2002) investigated the strengths and weaknesses of several different types of instruments that measure sediment compaction and shear resistance suggesting that other instruments may be more suitable for measuring beach compaction relative to sea turtle nesting behavior. Because of instrument error and given that turtles do not dig vertically in the same fashion as a penetrometer moves through the sediment layers, some have concluded that penetrometers are not appropriate for assessing turtle nesting limitations (Davis et al. 1999). However, even with this limitation, the hand-held cone-penetrometer remains the accepted method for assessing post-nourishment beach hardness.

According to Davis et al. (1999), on the Gulf Coast of Florida (1) there was no relationship between turtle nesting and sediment compactness, (2) the compactness ranges and varies widely in both space and time with little rationale, (3) tilling has a temporary influence on compactness and no apparent influence on nesting frequency, (4) and current compactness thresholds of 500 pounds per square inch (psi) are artificial. According to Brock (2005), the physical attributes of the fill sand for Brevard

County beaches did not result in severe compaction and therefore did not physically impede turtles in their attempts to nest. Therefore, additional studies should be considered to evaluate the validity of this threshold (500 PSI) and its general application across all beaches as a means to assess beach-tilling requirements. If sediment characteristics are similar to the native beach and sediment grain sizes are homogenous, the resultant compaction levels will likely be similar to the native beach and tilling should not be encouraged. A study by Nelson and Dickerson (1988b) documented that a tilled nourished beach will remain un-compacted for up to one year; however, this was a site-specific study and for some beaches it may not be necessary to till beaches in the subsequent years following nourishment.

Beach hardness impacts can be minimized by placing sand similar to the native beach In some cases, though sediment placed on the beach is similar to the native sediment characteristics and the resultant compaction is similar to the native beach, tilling is still encouraged regardless of compaction levels. It has been suggested that, in some cases, the process of tilling a beach, with compaction levels similar to native beach, may have an effect on sea turtle nesting behavior and nest incubation environment. Research on evaluating tilling impacts to nesting turtles is limited. Therefore, the idea of not tilling beaches (immediately following and/or during consecutive years after construction operations) where compatible sediments are used and compaction levels are similar to the native beach should be taken into consideration on a case-by-case basis in order to account for potential impacts of tilling activities on nest success.

Recognizing the recent literature on beach compaction measurements and associated tilling, as well as and the current concerns with the existing compaction evaluation and subsequent tilling process outlined in the USFWS general compaction guidelines, the USACE, in coordination with NCWRC and USFWS, has initiated a more qualitative approach for post construction compaction evaluations on North Carolina beaches where sediment meets the state compatibility standard. Results from this effort have recognized a reduction in the need for post construction tilling for many disposal and nourishment projects. Considering that only beach quality sediment will be placed on the beach as a component of this project, the USACE will continue to work with the Cape Lookout National Seashore (National Park Service), NCWRC and USFWS in this qualitative post construction compaction and tilling evaluation in order to assure that impacts to nesting and incubating sea turtles are minimized.

f. Lighting.

During beach disposal operations associated with the proposed project, lighting is required during nighttime activities at both the dredging site and the location on the beach where sediment is being placed. In compliance with the USACE Safety and Health Requirements Manual (2003), a minimum luminance of 30 lm/ft^2 is required for dredge operations and a minimum of 3 lm/ft^2 is required for construction activities on the beach. For dredging vessels, appropriate lighting is necessary to provide a safe working environment during nighttime activities on deck (i.e. general maintenance work deck, endangered species observers, etc.). During beach disposal operations, lighting is generally associated with the active construction zone around outflow pipe and the use of heavy equipment in the construction zone (i.e. bulldozers) in order to maintain safe operations at night.

Since all beach disposal events for the DMMP will take place outside the sea turtle nesting season (November 16 to April 30), the presence of artificial lighting on or within the vicinity of nesting beaches would not be detrimental to nesting female emergence, nest site selection, and the nocturnal sea-finding behavior of both hatchlings and nesting females.

g. Sediment Grain Size Analysis and Color of Maintenance Material Dredged from the Morehead City Harbor Navigation Channel Sediment Placed on Shackleford And Bogue Banks.

From the sediment analysis and surveys (USACE 2008, USACE 2002, and USACE 2011) the following conclusions can be made.

a. Grain size analysis. On Shackleford Banks, the mean grain size of beach sediments from the DB to the mean low water contour and from the trough to the -24 foot depth is 0.532 mm and 0.250 mm respectively. The maintenance sediment from the Morehead City Harbor navigation channels had a mean grain size of 0.267 mm. The frequency distributions of Shackleford Banks sediments from the TR to -24 ft portion of the beach were similar to the grain size distributions of the Morehead City Harbor sediments considered for beach disposal. The DB to -24 ft grain size frequency distribution for Shackleford sediments were slightly more negatively skewed (coarser) and flatter (less kurtosis) than the Harbor sediment distribution. Shackleford Banks sediments above the bar were typically coarser than Outer Harbor sediments and particularly so in the surf zone. The Shackleford Banks dune, dune base, and berm crest (mean grain sizes of 0.306 mm, 0.338 mm, and 0.359 mm respectively) were also coarser than Morehead City Harbor sediments (0.267 mm) but not as different as the beach sediments that included surf zone portions of the beach. The Morehead City Harbor sediments had slightly more slit content (passing #230 sieve) at 3.6% vs. 1.0 % from the Shackleford Banks DB to -24 ft sediment. The maintenance sediment from the navigation channel has slightly more visual shell content (16.0 % vs. 13.9 % DB to the -24 foot depth on Shackleford) than the native beach on Shackleford Banks.

On Shackleford Banks, the standard deviation of the native sediment from the base of the dune to the mean low water contour and from the trough to the -24 foot depth is 1.29 phi and 0.88 phi, respectively. The Harbor sediments had a standard deviation of 0.84 phi. These differences mean that both sediments are moderately sorted and the Shackleford sediments are less sorted than the Outer Harbor sediments.

Sediments used to replace natural beach sand should match the natural beach as closely as possible in order to minimize environmental effects. While the scientific literature agrees with this statement in principle, there is little data available to quantify precisely what similarity (or difference) is ecologically significant. Outer Harbor sediments at the time of disposal would be similar in terms of grain size distributions to portions of the Shackleford beach profile (specifically the submarine portions of the beach profile) and finer than other portions (specifically the subaerial portions of the beach). Harbor sediments placed on Shackleford Banks would be mobilized and redistributed under a variety of environmental conditions including winds, waves, longshore currents, offshore currents, and tides. As sand travels from the beach to the dunes, the coarse end of the placed sediment would likely lag behind, rendering the size curves better sorted and also positively skewed.

Over the long term, the speed and degree of ecological recovery largely depend on the physical characteristics of the beach habitat, mainly determined by (1) sediment quality and quantity, (2) the nourishment technique and strategy applied, (3) the location and the size of nourishment and (4) the physical environment prior to nourishment (Speybroeck, J. et al. 2006).

b. Color analysis. The maintenance sediment from the Morehead City Harbor navigation channel is slightly redder in hue (10 YR vs. 2.5 Y), slightly lighter in value (8 vs. 7), and slightly grayer in chroma (1 vs. 2) than the Shackleford Banks native beach.

The majority of the sediment from the navigation channel is only one increment higher or lighter than the native Shackleford beach (i.e., 8 vs. 7 on the native beach).

From the Munsell hue, value, and chroma measurements, there does not appear to be a significant difference between the color of the Shackleford native beach and the dredged sediment from the navigation channel.

Other Considerations

Two other considerations discussed in the following paragraphs were used to provide additional perspectives regarding the sediment proposed for disposal on Bogue Banks and Shackleford Banks and the sand of the receiving beaches. However, neither of these considerations represent requirements that directly apply to the DMMP disposal of dredged material from the Morehead City Harbor federal navigation project .

1. NC Technical Standards. Within the State of North Carolina's Coastal Management Program including !5A NCAC 07H .0312 TECHNICAL STANDARDS FOR BEACH FILL PROJECTS (hereafter the NC Technical Standards). These NC Technical Standards regard disposal of sediment along the oceanfront shoreline, referred to as beach fill. Beach fill projects include beach nourishment, dredged material disposal, habitat restoration, storm protection, and erosion control. The NC Technical Standards provide requirements for these projects to be permitted particularly with regard to characterization of sediment on the recipient beach and the sediment being placed. Within the NC Technical Standards, characterization of the recipient beach is not required for the disposal of sediment directly from and completely confined to a federally or state maintained navigation channel. For this reason, the NC Technical Standards do not specifically apply to the disposal of dredged material from the Morehead City Harbor federal navigation project.

The Shackleford Banks beach was sampled using methods similar to those specified in the NC Technical Standards (07 H.0312 (1)(c) and (d). The sampling of Shackleford included about 14 sediment samples were taken along each of 46 shore-perpendicular transects (from the beach dune to -30 foot elevation) about every 1,000 feet of shoreline on Shackleford Banks from Barden (Transect 00) to Beaufort (Transect 460) Inlets. Five samples were taken above MLW and eight samples were taken below MLW on Shackleford. The NC Technical Standards require a minimum of 5 shore perpendicular transects evenly spaced throughout the entire project area (but spaced no more than 5000 feet apart). The NC Technical Standards require transect to extend from the frontal dune crest seaward to a depth of -20 feet (6.1 meters) or to the shore-perpendicular distance 2,400 ft seaward of mean low water, whichever is in a more landward position. The total number of samples taken landward of MLW shall equal the total number of samples taken seaward of MLW.

Specific grain size analysis categories and composite approaches are required by the NC Technical Standards. These were performed for the Shackleford samples.

The NC Technical Standards indicate that sediment is compatible for use as beach fill if the following five criteria (i.e., a through e, below) are met:

a. Fine grained (less than 0.0625 mm) sediment is less than 10%,

b. The average percentage of fine grained (less than 0.0625 mm) sediment is less than 5% of the recipient beach, and

c. The average percentage of calcium carbonate (% shell) does not exceed 15% of the recipient beach.

d. The average percentage by weight of granular sediment (greater than or equal to 2 mm and less equal to 4.76 mm) in a borrow site shall not exceed the average percentage by weight of coarse sand sediment of the recipient beach characterization plus 5%.

e. The average percentage by weight of gravel (greater than or equal to 4.76 mm) in a borrow site shall not exceed the average percentage by weight of gravel sized sediment for the recipient beach characterization plus 5%.

Table J-6 below summarizes information applicable to the NC Technical Standards and all data found in Table J-6 is summarized from USACE 2002, USACE 2008, and USACE 2011. For all sediment samples on Bogue Banks, Shackleford Banks, and the Morehead City Harbor dredged material the percentage of visual shell (% visual shell) was visually estimated during the sieving procedure. The following paragraphs describe how the proposed action complies with the NC Technical Standards:

a. and b. The Morehead City Harbor sediments contain less than 10% fines (3.6% passing the #230 sieve (0.063 mm). For this comparison with the NC Criteria, the Shackleford dune (DN) to -24 ft data composite best matches the frontal dune to -20 ft depth sampling composite described in the NC Technical Standards. This Shackleford composite (recipient beach) contained 1.0% #230 fines. The Harbor sediment is less than 5% of the Shackleford sediment (i.e., 3.6% is less than 6% (1% plus 5% = 6%)).

c. The Morehead City Harbor sediments contains 16.0% visual shell. The Shackleford dune (DN) to -24 ft data composite best matches the frontal dune to -20 ft depth sampling composite described in the NC Technical Standards. This Shackleford composite (recipient beach) contained 13.9% visual shell. The Harbor sediment does not exceed 15% of the recipient beach (i.e., 16.0% is less than 28.9% (13.9% + 15% = 28.9%)).

d. Sediment which is greater (coarser) than or equal to 2 mm and less (finer) than 4.76 mm is the difference between that retained by the # 10 sieve (2.0 mm) and the #4 sieve (4.76 mm). For the Morehead City Harbor sediments the percent passing #4 sieve is 98.1% and passing #10 is 95.4%, a difference of 2.7%. For Shackleford Banks (DN to -24 depth) the percent passing the #4 sieve is 96.6% and passing the #10 sieve is 92.5%, a difference of 4.1%. The Harbor sediment is less than 5% of the Shackleford sediment (i.e., 2.7% is less than 9.1% (4.1% plus 5% = 9.1%)).

e. The sieve size of gravel (greater than or equal to 4.76 mm) is greater than the #4 sieve. The Morehead City Harbor sediment percent passing the #4 sieve is 98.1 and Shackleford Banks (DN to -24 foot depth) is 96.6. That means that the Harbor sediment is 1.9% (100 - 98.1 = 1.9%). Shackleford Banks is 3.4% (100 - 96.6 = 3.4%). Again the Harbor sediment is less than 5% of the Shackleford sediment (i.e., 1.9% is less than 8.4% (3.4% plus 5% or 8.4%).

Based on the sediment analysis, the Morehead City Harbor maintenance sediment meets the North Carolina compatibility criteria for disposal on Shackleford Banks.

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Sediment	No. of Samples	mm	phi	Std Dev phi	% Passing #4 sieve nominal size 4.76 mm	%Passing #10 sieve nominal size - 2.00 mm	% Passing #200 sieve nominal size - 0.074 mm	% Passing #230 sieve nominal size - 0.063 mm	%Visual Shell
Morehead City Outer Harbor Channel Sediments	130	0.267	1.90	0.84	98.1	95.4	3.6	3.6	16.0
Shackleford Banks Data All	647	0.323	1.63	1.10	96.7	92.9	1.9	1.5	12.3
Shackleford Banks Data DN to -24 ft	598	0.339	1.56	1.13	96.6	92.5	1.2	1.0	13.0
Shackleford Banks Data DB to -24 ft	552	0.344	1.54	1.20	96.3	91.9	1.3	1.0	13.9
Shackleford Banks Data DB to MLW	230	0.532	0.91	1.29	94.2	87.1	0.4	0.4	22.2
Shackleford Banks Data TR to -24 ft	322	0.25	2.00	0.88	97.8	95.3	1.9	1.5	8.0
Ft Macon	34	0.213	2.23	0.80	NR	99.0	1.6	NR	10.9
Atlantic Beach	82	0.183	2.45	0.79	NR	98.7	3.4	NR	7.1
Pine Knoll Shores	102	0.188	2.41	0.81	NR	98.4	3.6	NR	8.9
Indian Beach	34	0.205	2.28	0.93	NR	98.2	3.2	NR	10.9
East Emerald Isle	47	0.203	2.30	0.74	NR	98.8	2.6	NR	6.3
West Emerald Isle	67	0.193	2.37	0.68	NR	98.7	2.4	NR	4.9
Bogue Inlet Area	51	0.189	2.40	0.52	NR	98.9	1.9	NR	4.0

Table J-6. Summarizes Sediment Data Applicable to the North Carolina Technical Standards. All sediment data taken from USACE 2002, USACE 2008, and USACE 2011

Overfill Ratio [1]	MEAN (phi)	STD DEV (phi)	EPM [2]	ESM [3]
Morehead City Outer Harbor	1.90	0.84	NA	NA
Shackleford Banks Native Data DN to -24	1.56	1.13	1.22	1.49

[1] Assumed: Berm Height = 6' Berm Width = 150' Significant Wave Height = 6.2'

[2] Dean's (1991) Equilibrium Profile Method

[3] Pilarczyk et al. (1986) Equilibrium Slope Method

Table J-7. Summary of Overfill Ratios Calculated for the Disposal of Sediment on Shackleford Banks. All calculations used sediment data from USACE 2008 and 2011.

2. Overfill Ratio or Factor. Once Harbor sediment is placed on Shackleford beach, waves and currents will redistribute the material offshore and alongshore until a stable configuration is achieved. Depending on local conditions, sediment placed on Shackleford Banks may take several months or years to reach the equilibrium condition. The overfill ratio or factor is defined as the volume of material required to produce a unit volume of stable beach with the same grain size distribution as the native beach material.

An overfill factor is commonly used to evaluate the compatibility of the sediments and to relate the volume of borrow site sediment required for a project to perform similarly or comparably to the native beach sand. Thus, an "overfill" factor of 1.0 indicates direct compatibility (that is, borrow and native sands are identical) and an "overfill" factor of 1.1 indicates that the borrow site material is finer and thus 10 percent additional material disposal (coverage) is required to compensate for the incompatibility and expected loss of fine sediments. In other cases, the sediment size is predetermined because the sand is a by-product of an inlet channel maintenance project, and thus the design professional is evaluating only the expected longevity of the project.

There are a number of methods used to compute the overfill ratios, these include: Dean’s (1991) Equilibrium Profile Method (EPM) and Pilarczyk, Van Overeem, and Bakker’s (1986) Equilibrium Slope Method (ESM). These methods are briefly discussed below.

The Dean’s equilibrium profile method (Dean 1991) determines the volume of recharged sand of a given grain size to increase the width of dry beach by a given amount. Dean (1991) proposed that beach profiles develop a characteristic parabolic equilibrium profile.

The equilibrium slope method by Pilarczyk, van Overeem and Bakker (1986) bases the recharged profile on the present native profile. However if the grain size of the harbor sediment is different from the native beach, the profile steepness is altered.

Table J-7, above shows the results of the Dean’s (1991) EPM and Pilarczyk et al. (1986) ESM methods of calculating the overfill ratios for the disposal of Morehead City Harbor sediment on Shackleford Banks. Both EPM and ESM overfill ratios used the sediment data taken from USACE 2008 and USACE 2011. The range of the overfill ratio’s are from 1.22 to 1.49. The USACE believes that Dean’s (1991) EPM overfill ration of 1.22 is considered to be the most reliable overfill ration based on previous engineering experience and results. Dean’s (1991) EPM includes mathematical terms which take into consideration the fill height, the fill width, the significant wave height along with the native beach, and fill grain size mean and standard deviation.

(2) Dredging Impacts.

a. Food Supply.

After leaving the nesting beach, hatchling green and loggerhead turtles head towards the open ocean pelagic habitats (Carr 1987) where their diet is mostly omnivorous with a strong carnivorous tendency in green turtles (Bjorndal 1985). At about 20-25 cm carapace length Atlantic green turtles enter benthic foraging areas and shift to an herbivorous diet, feeding predominantly on sea grasses and algae but may also feed over coral reefs and rocky bottoms (Mortimer 1982). At about 40 to 50 cm carapace length, loggerheads move into shallow water where they forage over benthic hard and soft bottom habitats (Carr 1986). Loggerhead sea turtles feed on benthic invertebrates including mollusks, crustaceans, and sponges (Mortimer 1982) but have also been found to eat fish, clams, oysters, sponges, jellyfish, shrimp, and crabs when near shore. Hawksbill and Kemp's ridley sea turtles are carnivorous (Mortimer 1995) with a principal food source of crustaceans, mollusks, other invertebrates, and fish (Schwartz 1977). Hawksbills feed on encrusting organisms such as sponges, tunicates, bryozoans, mollusks, and algae; whereas Kemp's ridleys feed predominantly on portunid crabs (Bjomdal 1985). Leatherback sea turtles are carnivorous (Mortimer 1995) and feed primarily on cnidarians and tunicates (salps, pyrosomas) throughout the water column but are commonly observed feeding at the surface (Bjomdal 1985).

Dredging will be performed only within the existing authorized navigation channels within the Inner and Outer Morehead City Harbor and will not affect these resources in the inshore environment. Impacts on benthic habitat within the Nearshore Placement Areas off Bogue and Shackleford Banks will be minor as dredging will only affect a limited portion of the offshore benthic habitat. Hardbottom surveys and subsequent mapping were performed within all proposed placement areas (i.e., within the -25 foot depth of closure from Bogue to Beaufort Inlets and nearshore shore placement areas off Bogue and Shackleford Banks) and diver ground truth surveys were performed to characterize select sites within the -25 foot depth of closure from Bogue to Beaufort Inlets and side scan sonar surveys were completed within the nearshore placement areas. Impacts to sandy bottom foraging habitat are expected to be isolated and short term in duration. Therefore, the project should not significantly affect the food supply of benthic foraging sea turtles along the beach strand or in the offshore placement areas. Considering that leatherbacks feed primarily within the water column on non-benthic organisms, the project should not significantly affect the food supply of this species

b. Relationship to Critical Periods in Life Cycle.

Sea turtles migrate within North Carolina waters throughout the year, mostly between April and December. The dredging of sediment from designated and existing federal navigation channels will be performed using either a pipeline dredge, bucket and barge dredge or a hopper dredge. Hopper dredges potentially pose the greatest risk to benthic oriented sea turtles through physical injury or death by entrainment as the hopper dredge drag heads remove sediment from sea bottom.

In order to minimize potential impacts, hopper dredges will be used from January 1 to March 31, the timeframe when water temperatures are cooler and sea turtle abundance is low, generally <14°C (57.2°F). This hopper dredging window is more stringent than the December 1 to March 31 dates specified in the 1997 Regional Biological Opinion for the Continued Hopper Dredging Of Channels And Borrow Areas In the Southeastern United States. Minor deviations in the January 1 to March 31 dredging window (less than 1 week on either end of the window) may occur if approved by the Wilmington District Commander. However, because some sea turtle species may be found year-round in the offshore area, hopper-dredging activities may occur during low levels of sea turtle migration. Therefore, the proposed hopper dredging activities may adversely affect loggerhead, green, hawksbill, and Kemp's ridley sea turtles. Based on historic hopper dredging take data, leatherback sea turtles are not known to be impacted by hopper dredging operations. The USACE will abide by the provisions of the September 25, 1997 Regional Biological Opinion for The Continued Hopper Dredging Of Channels And Borrow Areas In The Southeastern United States or any superseding RBO provided by NMFS. To reduce impacts, the USACE anticipates taking certain precautions as prescribed by NMFS and USACE under standard hopper dredging protocol and will maintain observers on hopper dredges for the periods prescribed by NMFS to document any takes of turtle species and to ensure that turtle deflector drag heads are used properly.

(3) Summary Effect Determination.

All five species are known to occur within oceanic waters of the Federal navigation channels; however, only the loggerhead, green, and leatherback sea turtles are known to nest within the limits of the project beach disposal area. Therefore, species specific impacts may occur from both the beach disposal and dredging operations. The proposed DMMP disposal windows for Bogue and Shackleford Banks are: a pipeline dredge would work between the dates of November 16 and April 30 on Bogue Banks and November 16 and March 31 on Shackleford Banks (inclusive); and a hopper dredge would work between January 1 and March 31(inclusive). Considering the proposed dredging window to avoid the sea turtle nesting season to the maximum extent practicable, the proposed project may affect not likely to adversely affect nesting loggerhead, green, and leatherback sea turtles by altering nesting habitat. Since the Kemp's Ridley and Hawksbill sea turtles are not likely to nest on the beaches in the project area, the proposed DMMP is not likely to adversely affect these species.

Though significant alterations in beach substrate properties may occur with the input of sediment types from other sources, re-establishment of a berm and dune system with a gradual slope can enhance nesting success of sea turtles by expanding the available nesting habitat beyond erosion and inundation prone areas. As previously stated, in regards to suitability for nesting, turtles continue to nest on disposal beaches of Bogue Banks with hatch rate successes similar to non-disposal beaches (Matthew Godfrey, Personal Communication, 2010).

In the Morehead City Harbor, hopper dredging takes place only from January 1 to March 31 of any year and complies with the terms and conditions of the Regional Biological Opinion on hopper dredging by NOAA Fisheries, dated September 25, 1997 (NMFS 1997). NMFS Biological Opinion dated September 25, 1997 authorizes the continued hopper dredging of channels and borrow areas in the southeastern United States.

On 18 September 2008, the USACE provided NMFS with a revised Draft South Atlantic Regional Biological Assessment (SARBA). The USACE' SARBA would authorize the following activities: "*Dredging activities in the coastal waters, navigation channels (including designated Ocean Dredged Material Disposal Sites (ODMDS)), and sand mining areas in the South Atlantic Ocean from North Carolina/Virginia Border through and including Key West, Florida and the Islands of Puerto Rico and the U.S. Virgin Islands (USVI)*". Once NMFS provides the USACE with their Biological Opinion, any new conditions or restrictions would supersede the 1997 NMFS Biological Opinion. Hopper dredging within the Morehead City Harbor would comply with any new conditions and/or restrictions of the new NMFS BO.

As indicated in Section 5.00 of this BA (Commitments to Reduce Impacts), the USACE will comply with all previous agreements with the resource agencies. With these commitments in place, for any USFWS terrestrial environment designated as critical habitat, such as LOGG-T-NC-01(Northern Recovery Unit, North Carolina) , the proposed project will not result in an adverse modification of critical habitat for the threatened loggerhead sea turtle.

Additionally, pursuant to the NMFS Biological Opinion (BO) dated September 25, 1997 and the 2008 USACE revised Draft South Atlantic Regional Biological Assessment (SARBA), the continued hopper dredging of existing navigation channels is authorized and the USACE would comply with all conditions and/or restrictions. Hopper dredging activities will not result in an adverse modification of the NMFS' proposed critical habitat for the threatened loggerhead sea turtle (LOGG-N-3).

The proposed dredging and disposal activities associated with the DMMP may occur in areas used by migrating turtles. Hopper dredges pose a risk to benthic oriented sea turtles through physical injury or death by entrainment. Though the January 1 to March 31dredging window will avoid periods of peak turtle abundance during the warm water months, the risk of lethal impacts still exist as some sea turtle species may be found year-round in the offshore area. Therefore, the proposed hopper dredging activities may affect, likely to adversely affect the loggerhead, green, hawksbill, and Kemp's ridley sea turtles. Based on historic hopper dredging take data, leatherback sea turtles are not known to be impacted by hopper dredging operations.

4.02.9 Atlantic Sturgeon

a. Status. Endangered. Within Federal Register dated January 6, 2010 (Volume 75, Number 3), NMFS announced a 90-day finding on a petition to list Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) as endangered, or to list multiple distinct population segments (DPSs) as threatened or endangered and designate critical habitat under the Endangered Species Act. NMFS found the petition presents substantial scientific or commercial information indicating that the petitioned actions may be warranted. NMFS published the Final Listing for the Atlantic Sturgeon in the Federal Register dated February 6, 2012. NMFS has listed the Carolina and South Atlantic populations of Atlantic Sturgeon as endangered under the Endangered Species Act of 1973, as amended. This final rule is effective April 6, 2012. However, NMFS has not designated any "*critical habitat*" for this species. Since the Atlantic sturgeon is found within the project area, the purpose of this section is to address project impacts on this listed species.

b. Occurrence in Immediate Project Vicinity. Although specifics vary latitudinally, the general life history pattern of Atlantic sturgeon is that of a long lived, late maturing, estuarine dependent, an adromous species. The species' historic range included major estuarine and riverine systems that spanned from Hamilton Inlet on the coast of Labrador to the Saint Johns River in Florida (Murawski and Pacheco 1977; Smith and Clungston 1997).

Atlantic sturgeon spawn in freshwater, but spend most of their adult life in the marine environment. Spawning adults generally migrate up river in the spring/early summer; February-March in southern systems, April-May in mid-Atlantic systems, and May-July in Canadian systems (Murawski and Pacheco 1977; Smith 1985; Bain 1997; Smith and Clungston 1997; Caron et al. 2002). In some southern rivers, a fall spawning migration may also occur (Rogers and Weber 1995; Weber and Jennings 1996; Moser et al. 1998).

Atlantic sturgeon spawning is believed to occur in flowing water between the salt front and fall line of large rivers, where optimal flows are 46-76 cm/s and depths of 11-27 meters (Borodin 1925; Leland 1968; Crance 1987; Bain *et al*. 2000). Sturgeon eggs are highly adhesive and are deposited on the bottom substrate, usually on hard surfaces (e.g., cobble) (Gilbert 1989; Smith and Clungston 1997).

Upon reaching a size of approximately 76-92 cm, the subadults may move to coastal waters (Murawski and Pacheco 1977; Smith 1985), where populations may undertake long range migrations (Dovel and Berggren 1983 and Bain 1997). Tagging and genetic data indicate that subadult and adult Atlantic sturgeon may travel widely once they emigrate from rivers. Subadult Atlantic sturgeon wander among coastal and estuarine habitats, undergoing rapid growth (Dovel and Berggren 1983; Stevenson 1997). These migratory subadults, as well as adult sturgeon, are normally captured in shallow (10-50m) near shore areas dominated by gravel and sand substrate (Stein et al. 2004). Coastal features or shorelines where migratory Atlantic sturgeon commonly aggregate include the Bay of Fundy, Massachusetts Bay, Rhode Island, New Jersey, Delaware, Delaware Bay, Chesapeake Bay, and North Carolina, which presumably provide better foraging opportunities (Dovel and Berggren 1983; Johnson et al. 1997; Rochard et al. 1997; Kynard et al. 2000; Eyler et al. 2004; Stein et al. 2004; Dadswell 2006).

c. Current Threats to Continued Use of the Area. According to the Atlantic sturgeon status review (Atlantic Sturgeon Status Review Team 2007), projects that may adversely affect sturgeon include dredging, pollutant or thermal discharges, bridge construction/removal, dam construction, removal and relicensing, and power plant construction and operation. Potential direct and indirect impacts associated with dredging that may adversely impact sturgeon include entrainment and/or capture of adults, juveniles, larvae, and eggs by dredging and trawling activities, short-term impacts to foraging and refuge habitat, water quality, and sediment quality, and disruption of migratory pathways.

d. Project Impacts.

(1) Habitat and Food Supply. It is not known how extensively the Morehead City Harbor navigation reaches are used by sturgeon as feeding areas. Furthermore, specific aggregation areas for spawning, feeding, resting, etc. have not been identified for all dredging locations throughout the distribution range for Atlantic sturgeon. However, based on the current understanding of the variables required (ie. salinity regime, depth, substrate, etc.) for various stages of the sturgeon life cycle (ie. spawning, migrating, foraging, etc.), dredging activities presumably create some level of disruption based on their location relative to the life stage requirements. Channels maintained at frequent dredging intervals are not expected to be used extensively for feeding or other activities. As identified in the 2007 Status Review of Atlantic Sturgeon, "Hatin *et al.* (*in press*) tested whether dredging operations affected Atlantic sturgeon behavior by comparing Catch Per Unit Effort (CPUE) before and after dredging events in 1999 and 2000. The authors documented a three to seven-fold reduction in Atlantic sturgeon presence after dredging operations began, indicating that sturgeon avoid these areas during operations." Dredging activities performed in areas identified as

known high aggregation areas for spawning, feeding, resting, etc., which require specific measures to minimize impacts, may require separate consultation.

Dredging activities can impact benthic assemblages either directly or indirectly and may vary in nature, intensity, and duration depending on the project, site location, and time interval between maintenance operations. Direct catastrophic impacts include physical removal or smothering by the settlement of suspended materials (Morton 1977; Guillory 1982). Suspended materials may also interfere in the feeding respiration or reproduction of filter feeding benthos and nekton (Sherk and Cronin 1970). Though initial loss of benthic resources are likely, quick recovery between 6-months (McCauley et al. 1977; Van Dolah et al. 1979; Van Dolah et al*.* 1984; and Clarke and Miller-Way 1992) to two years (Bonsdorff 1980; Ray 1997) is expected; thus, the impacts to sturgeon foraging habitat are expected to be short-term. Recent benthic studies in Savannah Harbor, just prior to annual maintenance dredging, have shown primarily healthy benthic communities both inside and outside the channel. For most sediment types, average abundance and biomass were found to be higher inside the channel compared to locations outside the channel with the exception of silt-sand substrates (USACE 2008). Sturgeon foraging sites with soft mud bottoms and oligohaline or mesohaline salinities tend to recover quickly, likely due to the dominance of opportunistic species assemblages (e.g., *Streblospio benedicti, Capitella capitata, Polydora Ligni*) (Ray 1997). Recovery in dredged sites occurs by four basic mechanisms: remnant (undredged) materials in the sites, slumping of materials with their resident fauna into the site, adult immigration, and larval settlement. Remnant materials, sediments missed during the dredging operation, act as sources of “seed” populations to colonize recently defaunated sediments. Adult immigration can occur as organisms burrow laterally throughout the sediments, drift with currents and tides, or actively seek out recently defaunated sediments (Ray 1997). Likewise materials slumping or falling into the site from channel slopes provide organisms for colonization (Kaplan et al. 1975). During periods of extreme conditions (i.e. extreme temperature regimes, low dissolved oxygen, etc.), sturgeon may become relatively immobile and forage extensively in one area. Therefore, considering that limited mobility would not allow for sturgeon to move to more productive foraging grounds following dredging activities, it is possible that reduced benthic assemblages during site and time specific conditions could have a more significant impact to foraging behavior.

For benthic assemblages in estuarine and riverine systems, the distribution of individual species is consistent with their known sediment and salinity preferences (polyhaline, mesohaline, and oligohaline). The distribution of each of these assemblages varies depending on the intensity of river flow, often correlated with season (Ray 1997; Posey *et al*. 1996). Therefore, in addition to the anthropogenic dredging impacts to benthic assemblages, natural community shifts are correlated with river flow rates. Considering the ephemeral nature of this environment, the benthic assemblages consist of opportunistic species which are capable of adapting to natural fluctuations in the environment (Ray 1997). Furthermore, assuming that natural benthic community shifts are an inherent component of sturgeon foraging behavior, it is possible that post dredging movements to more productive foraging grounds are not far outside of the normal foraging behavior response to natural benthic community shifts.

Extensive studies have been done on the behavioral responses of fish to increased turbidity. These studies measured reactions such as cough reflexes, swimming activity, gill flaring, and territoriality that may lead to physiological stress and mortality; however, specific studies on sturgeon responses are limited. The effects of suspended sediment on fish should be viewed as a function of concentration and exposure duration (Wilber and Clarke 2001). The behavioral responses of adult salmonids for suspended sediment dosages under dredging-related conditions include altered swimming behavior, with fish either attracted to or avoiding plumes of turbid water (Newcombe and Jensen 1996)

Water quality impacts to sturgeon as a result of proposed dredging activities are expected to be temporary, with suspended particles settling out within a short time frame. These sediment disturbance impacts are expected to be minimal in nature and are not expected to have a measurable effect on water quality beyond the frequent natural increases in sediment load. Considering that no new work or deepening beyond existing authorizations will occur as part of this action, no significant changes in salinity and tidal amplitude are expected within channels that have been dredged to their fully authorized channel depths and widths.

(2) <u>Relationship to Critical Periods in Life Cycle</u>. Assuming that channel shoaling is a result of transport of sediment from littoral drift or other nearby areas, the composition of maintenance material dredged from the channel is expected to be the same as that remaining upon completion of dredging. Therefore, no impacts to sturgeon from alterations to hydrodynamic regime or additional loss of physical habitat (i.e. changes in benthic substrate) are expected. Understanding that the existing Federal navigation channels will not be deepened and/or widened, no suspension of contaminants is expected from the dredging of previously undisturbed sediments.

(3) <u>Effect Determination</u>. Based on the history of incidental take data collected, both hydraulic (cutterhead and hopper) and mechanical dredge techniques have been documented to directly impact Atlantic sturgeon species through entrainment of the cutterhead or drag head or capture in the clamshell bucket. Hydraulic and mechanical dredging techniques may also indirectly impact sturgeon species through (1) short-term impacts to benthic foraging and refuge habitat, (2) short-term impacts to water and sediment quality from re-suspension of sediments and subsequent increase in turbidity/siltation, and (3) disruption of spawning migratory pathways. Therefore, all proposed hydraulic and mechanical dredging activities, may affect likely to adversely affect the Atlantic sturgeon species either directly or indirectly,

Endangered species observers (ESOs) on board hopper dredges will be responsible for monitoring for incidental take of Atlantic sturgeon. For hopper dredging operations, drag heads as well as all inflow and overflow screening will be inspected for sturgeon species following the same ESO protocol for sea turtles. Furthermore, all ESOs on board the dredge will be capable of identifying Atlantic sturgeon as well as following safe handling protocol as outlined in Moser *et. al.* 2000.

4.02.10 Shortnose Sturgeon

a. Status. Endangered

b. Occurrence in Immediate Project Vicinity. This species ranges along the Atlantic seaboard from southern Canada to northeastern Florida (USFWS 1999b). The shortnose sturgeon feeds on invertebrates and stems and leaves of macrophytes. From historical accounts, it appears that this species was once fairly abundant throughout North Carolina waters, however, many of these early records are unreliable due to confusion between this species and the Atlantic sturgeon (*Acipenser oxyrhynchus*). Because of the lack of suitable freshwater spawning areas in the project area and the requirement of low salinity waters by juveniles, any shortnose sturgeons present would most likely be non-spawning adults. This species ranges along the Atlantic seaboard from the Saint Johns River in New Brunswick, Canada, to the Saint Johns River, Florida. The distribution of the shortnose sturgeon in the Newport and White Oak Rivers is not known. No known records of the shortnose sturgeon have been documented in the project area. According to Kynard (1997), “No known populations occur from the Delaware River, New Jersey to the Cape Fear River, in North Carolina.”

c. Current Threats to Continued Use of the Area. Pollution, blockage of traditional spawning grounds, and over fishing is generally considered to be the principal causes of the decline of this species. The prohibition on taking any sturgeon in North Carolina should help to protect the species from commercial and recreational fishing pressure.

d. Project Impacts.

(1) Habitat. Spawning habitat for the shortnose sturgeon should lie well outside of the project area and should not be affected by the DMMP. Habitat conditions suitable for juveniles and adults could occur within the project area. The presence of juvenile shortnose sturgeon is not likely due to high salinity. Adults are found in shallow to deep water (6 to 30 feet) and will be expected to occupy the river channel during the day and the shallower areas adjacent to the channel during the night.

(2) Food Supply. The shortnose sturgeon is a bottom feeder, consuming various invertebrates and occasionally plant material. Adult foraging activities normally occur at night in shallow water areas adjacent to the deep-water areas occupied during the day. Juveniles are not known to leave deep-water areas and are expected to feed there.

All estuarine bottoms dredged as a part of maintenance will suffer temporary declines in benthic fauna populations in comparison to adjacent undisturbed areas. Existing channel bottoms will continue to be dredged at the same frequency as under existing conditions and will be expected to continue to support benthic populations similar to the existing populations.

Because most of the available shallow water feeding areas adjacent to the channel will not be affected by the project and channel benthic populations should continue to have their existing levels of production, it is believed that the food supply of the shortnose sturgeon will remain essentially at current levels with implementation of the DMMP.

(3) Relationship to Critical Periods in Life Cycle. Because of the mobility of adult and juvenile shortnose sturgeon and infrequent occurrence in the harbor, direct mortality as a result of dredging is not likely to occur.

(4) Effect Determination. Because no known shortnose sturgeon have been documented in the project area, it has been determined that the proposed action is not likely to affect any of this species or its habitat. It is unlikely that the shortnose sturgeon occurs in the project area (F. Rohde, Biologist NMFS, August 13, 2010, pers. comm. and Kynard 1997). However, should it occur, its habitat would be only minimally altered by dredging and disposal of maintenance dredged material. This species feeds on a wide variety of invertebrates and while some food resources may be initially affected by either burial associated with beach disposal, most invertebrates will quickly reestablish from adjacent unaffected areas.

Endangered species observers (ESOs) on board hopper dredges will be responsible for monitoring for incidental take of shortnose sturgeon. For hopper dredging operations, drag heads as well as all inflow and overflow screening will be inspected for shortnose sturgeon species following the same ESO protocol for sea turtles. Furthermore, all ESOs on board the dredge will be capable of identifying shortnose sturgeon as well as following safe handling protocol as outlined in Moser *et. al.* 2000.

Although hopper dredges have been known to impact shortnose sturgeons, this species is not likely to be present in the project area and, therefore, impacts from dredges are not anticipated to occur. Because of the unlikelihood of shortnose sturgeon being present in the project area and because of the precautions being taken with the hopper dredges, it has been determined that the actions of the proposed project are not likely to adversely affect the shortnose sturgeon.

4.02.11 Smalltooth Sawfish

Detailed life history information associated with the life cycle requirements for smalltooth sawfish and a subsequent analysis of impacts from the proposed dredging activities are provided within the following Section 7 consultation document:

USACE. September 2008. Regional Biological Assessment for Dredging Activities in the Coastal Waters, Navigation Channels (including designated Ocean Dredged Material Disposal Sites (ODMDS)), and Sand Mining Areas in the South Atlantic Ocean. USACE, Wilmington District. Submitted to NMFS on 12 September 2008

A summary of project specific information and associated impacts is provided in the ensuing text.

a. Status. Endangered. The U.S. smalltooth sawfish distinct population segment (DPS) was listed as endangered under the ESA on April 1, 2003 (68 FR 15674) and is the first marine fish to be listed in the United States.

b. Occurrence in Immediate Project Vicinity. Historic records suggest that during the 19th century the smalltooth sawfish was a common resident of the Atlantic and Gulf coastal waters of the southeastern United States. Throughout the 20th century it was recorded with declining frequency and today it can be no longer considered a functional member of the nearshore coastal community of the northwest Atlantic. Historic records indicate that the smalltooth sawfish abundantly occurred in the mid-Atlantic region only during the summer months (Adams and Wilson 1995). The smalltooth sawfish range has subsequently contracted to peninsular Florida and, within that area, can only be found with any regularity off the extreme southern portion of the state between the Caloosahatchee River and the Florida Keys (Figure J-4). Smalltooth sawfish are most common within the boundaries of the National Everglades National Park and the Florida Keys, and become less common with increasing distance from this area (Simpfendorfer 2002).

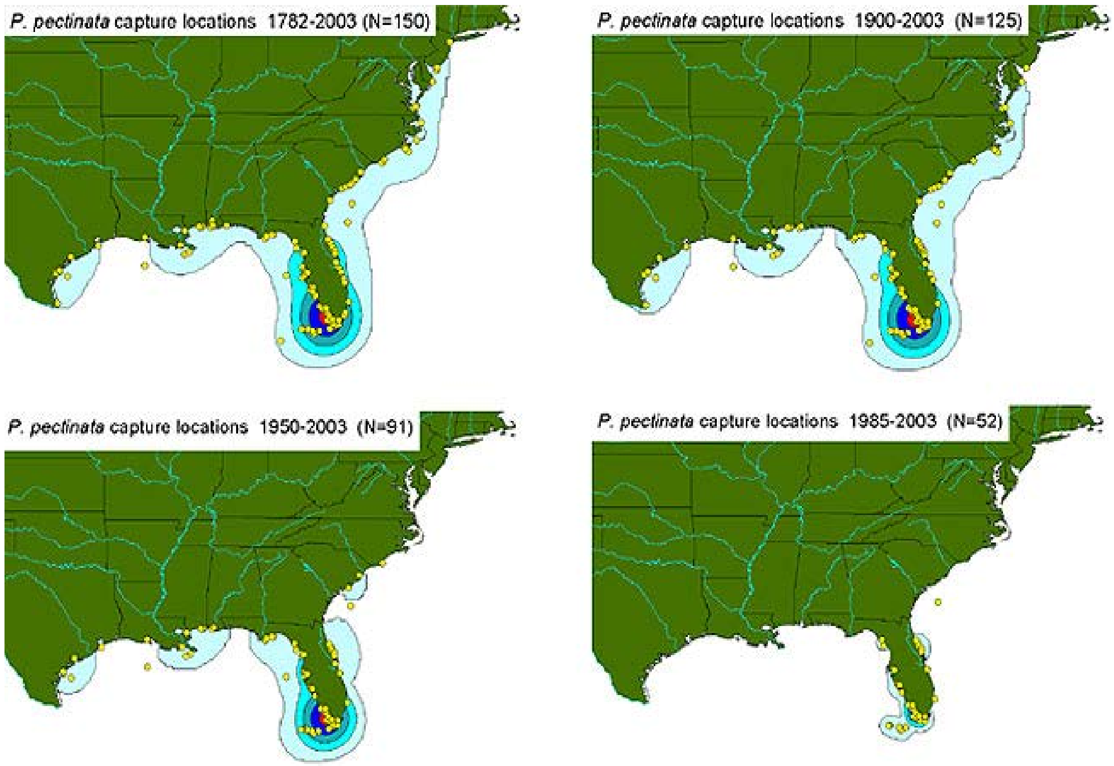

Figure J-4. Historic and Current Distribution of Smalltooth Sawfish in the U.S. (Burgess et al*.* 2003).

c. Current Threats to Continued Use of the Area. The principal habitats for smalltooth sawfish in the southeast U.S. are the shallow coastal areas and estuaries, with some specimens moving upriver in freshwater (Bigelow and Schroeder 1953). The continued urbanization of the southeastern coastal states has resulted in substantial loss of coastal habitat through such activities as agricultural and urban development; commercial activities; dredge and fill operations; boating; erosion and diversions of freshwater run-off (SAFMC 1998). Smalltooth sawfish may be especially vulnerable to coastal habitat degradation due to their affinity to shallow, estuarine systems. Smalltooth sawfish have historically been caught as by-catch in various fishing gears throughout their historic range, including gillnet, otter trawl, trammel net, seine, and to a lesser degree, hand line. Today, they are occasionally incidentally caught in commercial shrimp trawls, bottom longlines, and by recreational rod-and-reel gear. With the K-selected life history strategy of smalltooth sawfish, including slow growth, late maturation, and low fecundity, long-term commitments to habitat protection are necessary for the eventual recovery of the species. A complete review of the factors contributing to the decline of the smalltooth sawfish can be found in the "Status Review of Smalltooth Sawfish (*Pristis pectinata*)", (NMFS 2000). The Draft Recovery plan for smalltooth sawfish

(NMFS 2006) also presents a detailed threats assessment with four major categories of threats: 1) Pollution; 2) Habitat degradation or loss; 3) Direct injury and 4) Fisheries Interactions. Neither of these discussions will be repeated in detail in this assessment, but are incorporated herein by reference.

d. Project Impacts. As identified in the August 2006 Draft Smalltooth Sawfish Recovery Plan, "habitat effects of dredging include the loss of submerged habitats by disposal of excavated materials, turbidity and siltation effects, contaminant release, alteration of hydrodynamic regimes, and fragmentation of physical habitats (SAFMC 1998). Cumulatively, these effects have degraded habitat areas for smalltooth sawfish." The current range of sawfish has contracted to peninsular Florida and can only be found with any regularity off the extreme southern portion of the state. Smalltooth sawfish occur in shallow estuarine environments and juvenile sawfish are particularly dependent on mangrove habitat.

In the Gulf of Mexico Regional Biological Opinion (GRBO) issued by NMFS on November 19, 2003 (as amended in 2005 and 2007), in the section entitled "Species Not Likely to Be Affected," NMFS concludes the following: **"**Smalltooth sawfish (*Pristis pectinata*) are tropical marine and estuarine fish that have the northwestern terminus of their Atlantic range in the waters of the eastern U.S. Currently, their distribution has contracted to peninsular Florida and, within that area, they can only be found with any regularity off the extreme southern portion of the state. The current distribution is centered in the Everglades National Park, including Florida Bay. They have been historically caught as by-catch in commercial and recreational fisheries throughout their historic range; however, such by-catch is now rare due to population declines and population extirpations. Between 1990 and 1999, only four documented takes of smalltooth sawfish occurred in shrimp trawls in Florida (Simpfendorfer 2000). After consultation with individuals with many years in the business of providing qualified observers to the hopper dredge industry to monitor incoming dredged material for endangered species remains (Personal Communication, Chris Slay, Coastwise Consulting, August 18, 2003) and a review of the available scientific literature, NOAA Fisheries determined that there has never been a reported take of a smalltooth sawfish by a hopper dredge, and such take is unlikely to occur because of smalltooth sawfishes affinity for shallow, estuarine systems."

(e) Effect Determination. Based on the current South Atlantic distribution of smalltooth sawfish and only one sighting in North Carolina since 1999, dredging impacts to smalltooth sawfish within the project area are unlikely. Additionally, the take of a smalltooth sawfish by any dredge is unlikely considering the smalltooth sawfishes affinity for shallow, estuarine systems as well as the fact that there has never been a reported take of a smalltooth sawfish by a dredge. Therefore, implementation of the DMMP is not likely to adversely affect smalltooth sawfish.

4.02.12 Seabeach Amaranth

a. Status. Threatened

b. Occurrence in Immediate Project Vicinity. Seabeach amaranth is an annual herb that occurs on beaches, lower foredunes, and overwash flats (Fussell 1996). Weakley (1986) found that in North Carolina the plant is most common on overwash flats on accreting ends of barrier islands. This species occupies elevations ranging from 0.2 to 1.5 m above mean high tide (Weakley and Bucher 1992). Historically, seabeach amaranth was found from Massachusetts to South Carolina. But according to recent surveys (USACE 1992-2002), its distribution is now restricted to North and South Carolina with several populations on Long Island, New York. The decline of this species is caused mainly by development of its habitat, such as inlet areas and barrier islands, and increased ORV and human traffic, which tramples individuals (Fussell 1996). Seed dispersal of seabeach amaranth is achieved in a number of ways, including water and wind dispersal (USFWS 1995).

Seabeach amaranth usually grows between the seaward toe of the dune and the limit of the wave uprush zone. Greatest concentrations of seabeach amaranth occur near inlet areas of barrier islands, but in favorable years many plants may occur away from inlet areas. It is considered a pioneer species of accreting shorelines and stable foredune areas.

Since 1991, the USACE has surveyed Bogue Banks for seabeach amaranth. Table J-8 indicates numbers of plants were found on Bogue Banks.

Table J-8. Number of seabeach amaranth growing on Bogue Banks.

Year - Number of Plants	Year - Number of Plants
1992 - 2,557	2002 – 2,001
1993 – 3,762	2003 – 5,330
1994 – 1,181	2004 – 2,935
1995 – 14,776	2005 – 10,712
1996 – none (Hurricanes Bertha & Fran),	2006 – 251
1997 – 81	2007 – 130
1998 – 3,973	2008 – 313
1999 – 218	2009 – 281
2000 – 20	2010 – 69
2001 – 347	

These numbers include the Towns of Emerald Isle and Indian Beach/Salter Path, which is not within the project area. Between 1996 and 2010, at least seven hurricanes (Bertha, Fran, Bonnie, Dennis, Floyd, Irene, and Isabel) have affected this area. Seabeach amaranth populations on Bogue Banks may have fluctuated because of these named storms.

The Cape Lookout National Seashore, NPS also monitors seabeach amaranth growing on Shackelford Banks. The following information in Table J-9 is provided from their annual monitoring reports (provided by Michael Rikard, NPS):

Table J-9. Number of seabeach amaranth growing on Shackleford Banks.

Year	Number of Plants
1993	975
1994	948
1995	1155
1996	3
1997	51
1998	369
1999	9
2000	13
2001	126
2002	261
2003	1354
2004	58
2005	671
2006	30
2007	125
2008	76
2009	100

c. Current Threats to Continued Occurrence in the Project Area. Beach erosion is probably the primary threat to the continued presence in the area since the population was thriving prior to the recent frequent occurrence of hurricanes. However beach bulldozing and sand fencing by private interests may have affected the population on Bogue Banks.

d. Project Impacts.

(1) Habitat. The proposed 3.65 mile long beach disposal area on Shackleford Banks is not currently conducive to the growth of seabeach amaranth due to the high erosion and inundation throughout its habitat. Beach disposal would restore approximately 33 acres (150-foot wide times 9,636 foot long divided by 43,560) of new ocean beach on Shackleford Banks, which provides much of the habitat requirements for seabeach amaranth. Indeed, new populations have been observed to follow sand disposal on other beaches where sand has been placed by the USACE.

Beach disposal will not occur in the inlet areas where amaranth most commonly occurs.

(2) Relationship to Critical Periods in Life Cycle. Beach disposal would be conducted only from November 16 to April 30 on Bogue Banks and from November 16 to March 31 on Shackleford Banks. However, only a portion of the beach is affected at any point in time (approximately 4-5,000 feet per month). Once disposal passes that point, recovery can begin to occur. All of Fort Macon State Park, Shackleford Banks and the majority of Atlantic Beach will have dredged material placed during the colder months when the plants have not germinated. If there is sufficient material, beach disposal activities to Pine Knoll Shores will take place during the warmer months (within the beach disposal window). While such disposal is not an ideal management practice for the species, the restoration of the habitat is of prime importance. The project area would be included in the USACE monitoring program during the seabeach amaranth growing season for the life of the beachfill.

(3) Effect Determination. While beach disposal of dredged material once every three years within the 3.65 mile long area on Shackleford Banks will restore about 33 acres of oceanfront habitat lost to erosion, disposal on a portion of the beaches in the growing season may slow population recovery over the short term. Therefore, the project “may affect not likely to adversely affect” seabeach amaranth.

5.00 COMMITMENTS TO REDUCE IMPACTS TO LISTED SPECIES

The following is a summary of environmental commitments to protect listed species related to the construction and maintenance of the proposed project. These commitments address agreements with resource agencies and construction practices:

1. The USACE will strictly adhere to all conditions outlined in the most current National Marine Fisheries Service RBO for dredging of channels and borrow areas in the southeastern United States. Furthermore, as a component of this project, hopper dredging activities occur within the dredging window of January 1 to March 31 in order to avoid periods of peak sea turtle abundance. The use of turtle deflecting dragheads, inflow and/or overflow screening, and NMFS certified turtle and whale observers will also be implemented.

2. NMFS certified endangered species observers (ESOs) will be on board all hopper dredges and will record all large whale sightings and note any potential behavioral impacts. The USACE and the Contractor will keep the date, time, and approximate location of all marine mammal sightings. Care will be taken not to closely approach (within 300 feet) any whales, manatees, or other marine mammals during dredging operations or transportation of dredged material. An

observer will serve as a lookout to alert the dredge operator and/or vessel pilot of the occurrence of these animals. If any marine mammals are observed during other dredging operations, including vessel movements and transit to the dredged material disposal site, collisions shall be avoided either through reduced vessel speed, course alteration, or both.

3. The USACE will avoid the sea turtle nesting season. Disposal of beach compatible sediment on Bogue Banks will take place from November 16 to April 30 and on Shackleford Banks from November 16 to March 31 (if a pipeline dredge is used) and from January 1 to March 31 (if a hopper dredge is used).

4. The beach will be monitored for escarpment formation by the Contractor prior to completion of beach disposal activities. Escarpments which exceed 18 inches in height for a distance of 100 ft. will be leveled by the Contractor. . If it is determined that escarpment leveling is required during the nesting or hatching season, leveling actions should be directed by the USFWS and the Cape Lookout National Seashore (National Park Service).

5. Only beach quality sediment will be placed on the beach as a component of the DMMP. Post nourishment beach compaction (hardness) will be evaluated by the USACE, in coordination with the Cape Lookout National Seashore (National Park Service), NCWRC and USFWS, using qualitative assessment techniques to assure that impacts to nesting and incubating sea turtles are minimized and, if necessary, identify appropriate mitigation responses.

6. Monitoring for seabeach amaranth on Bogue Banks will be implemented to assess the post nourishment presence of plants. This survey will broken down into survey reaches for each town in accordance with the designated USACE sea beach amaranth survey reaches from 1991-2010 in order to maintain consistent data and survey techniques over time and results will be provided to USFWS. Monitoring for seabeach amaranth on Shackleford Banks will be implemented by the Cape Lookout National Seashore (National Park Service).

7. The USACE will implement precautionary measures for avoiding impacts to manatees during construction activities as detailed in the “Guidelines for Avoiding Impacts to the West Indian Manatee in North Carolina Waters” established by the USFWS.

SUMMARY EFFECT DETERMINATION

Threatened and endangered species summary effect determination for beach disposal and dredging activities associated with the proposed project area (No Effect (NE – green); May Affect Not Likely to Adversely Affect (MANLAA – orange); May Affect Likely to Adversely Affect (MALAA – red), and Not Likely to Adversely Modify (NLAM - orange) Critical Habitat.

Listed Species Within Project Area		Effect Determination	
		Beach Placement Activities (USFWS)	**In-Water Dredging Activities (NMFS)**
Sea Turtles	**Leatherback**	MANLAA	MANLAA
	Loggerhead	MANLAA	MALAA
	Green	MANLAA	MALAA
	Kemp's Ridley	NE	MALAA
	Hawksbill	NE	MALAA
Large Whales	**Blue, Finback, Sei, and Sperm**	NE	NE
	NARW	NE	MANLAA
	Humpback	NE	MANLAA
	West Indian Manatee	NE	MANLAA
	Roseate Tern	NE	NE
	Red Knot	MANLAA	NE
	Piping Plover and Critical Wintering Habitat	MANLAA/NLAM	NE
	Atlantic Sturgeon	NE	MALAA
	Shortnose Sturgeon	NE	NE
	Smalltooth Sawfish	NE	NE
	Seabeach Amaranth	MANLAA	NE
	Rough-Leaved Loosestrife	NE	NE
	rare butterfly (*Atrytonopsis* new species 1)	NE	NE
	American Alligator	NE	NE
	Eastern Cougar	NE	NE
	Red-cockaded Woodpecker	NE	NE

Table J-10. T&E species effects determination for beach disposal and dredging activities associated with the proposed project area (Notes: No Effect (NE = green), May Affect Not Likely to Adversely Affect (MANLAA = orange), and May Affect Likely to Adversely Affect (MALAA = red).

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APPENDIX K

CUMULATIVE IMPACT ASSESSMENT

Cumulative Impact Assessment

The Council on Environmental Quality (CEQ) defines cumulative impact as:

*The impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (*40 CFR 1508.7). This analysis follows the 11-step process outlined by the Council on Environmental Quality (CEQ) in their 1997 publication <u>Considering Cumulative Effects Under the National Environmental Policy Act (see Table K-1).</u>

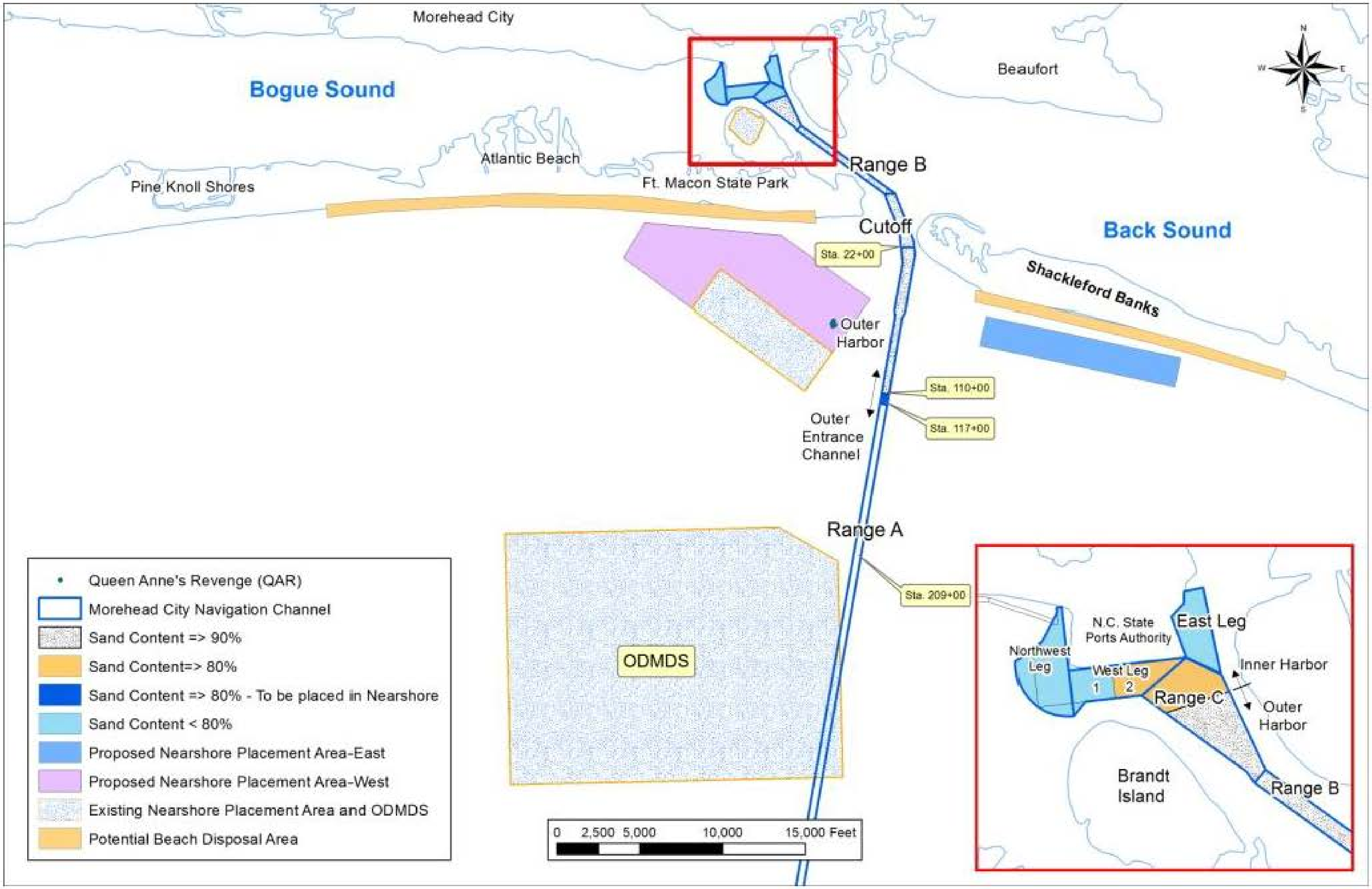

Figure K-1. Morehead City Harbor DMMP showing Ranges and Dredged Material Disposal Areas

Table K-1. Steps in the Cumulative Effects Analysis (as adapted from CEQ 1997)

Environmental Impact Assessment Components	CEQ Steps
I. Scoping	a. Identify the significant cumulative effects issues associated with the proposed action and define the assessment goals. b. Establish the geographic scope for the analysis. c. Establish the time frame for the analysis. d. Identify other actions affecting the resources, ecosystems, and human communities of concern.
II. Describing the Affected Environment	a. Characterize the resources, ecosystems, and human communities identified in scoping in terms of their response to change and capacity to withstand stresses. b. Characterize the stresses affecting these resources, ecosystems, and human communities and their relation to regulatory thresholds. c. Define a baseline condition for the resources, ecosystems, and human communities.
III. Determining the Environmental Consequences	a. Identify the important cause-and-effect relationships between human activities and resources, ecosystems, and human communities. b. Determine the magnitude and significance of the cumulative effects. c. Modify or add alternatives to avoid, minimize, or mitigate significant cumulative effects. d. Monitor the cumulative effects of the selected alternative and adapt management.

In order to reduce duplication, additional detailed information on Scoping, the Affected Environment, and the Environmental Consequences are found in Sections 7.1, 4.0, and 5.0 of the Draft Integrated DMMP and EIS (here after referred to as the DMMP). The proposed monitoring plan is found in Appendix F of the DMMP.

I. Significant Cumulative Effects Issues

A. Introduction. This assessment of cumulative impacts will focus on impacts of the proposed action on significant coastal shoreline resources off Bogue and Shackleford Banks. Additionally, the future construction and expansion activities of the North Carolina State Port Authority in Morehead City and Carteret

County’s Beach renourishment plans for Bogue Banks will be included in this assessment.

The DMMP impacts would deal with the future maintenance dredging of the existing Federal navigation channels and placement areas indicated in Figure K-1: the existing upland diked disposal area on Brandt Island, Ocean Beaches on Bogue and Shackleford Banks, nearshore areas off Bogue and Shackleford Banks, and the US EPA approved Morehead City ODMDS.

In making this assessment, the US Army Corps of Engineers, Wilmington District (USACE) has reviewed the reports mentioned in Tables K-2 and K-3. Additionally, the following reports included comprehensive assessments of state-wide cumulative impacts:

1. U.S. Army Corps of Engineers Draft Evaluation Report and Environmental Assessment, Morehead City Harbor Section 933, dated May 2003

2. U.S. Army Corps of Engineers Final Integrated General Reevaluation Report and Environmental Impact Statement, Shore Protection, West Onslow Beach and New River Inlet (Topsail Beach), North Carolina, dated March 2009,

3. U.S. Army Corps of Engineers Final Integrated General Reevaluation Report and Environmental Impact Statement, on Coastal Storm Damage Reduction, Surf City and North Topsail Beach, North Carolina, dated November 2010.

In discussing the potential cumulative impacts of the placement of sediment within the nearshore areas, and the beaches of Bogue and Shackleford Banks, the USACE considered time crowded perturbations, and space crowded perturbations, as defined below, to be pertinent to this action.

Time crowded perturbations *– repeated occurrence of one type of impact in the same area.*
Space crowded perturbations *– a concentration of a number of different impacts in the same area.*

B. Future Port Expansion and Carteret County’s Renourishment Projects in the Project Area.

North Carolina State Ports Authority (NCSPA) Radio Island Expansion. The NCSPA maintains harbor facilities that are adjacent to the federally maintained navigation channel in Morehead City Harbor. These areas include berthing areas along the face of the Morehead City State Port wharfs and facilities along Radio Island. Maintenance of these facilities is required to realize the benefits of having a channel leading to the port. Maintenance of these areas is usually performed at the same time that the maintenance of the Federal portion is accomplished.

In addition, the NCSPA is pursuing port industrial development on Radio Island (NCSPA 2001). The adjacent deep-water Federal navigation channel, the short distance to the open Atlantic Ocean, and existing rail and road access contribute to the benefits of this site for port development. The North Carolina State Ports Authority (NCSPA) property also includes approximately 185 acres of Radio Island, including the former Aviation Fuel Terminal Inc. The public uses the eastern portion of Radio Island, known as East Beach, for recreational purposes. The northern end of the island contains a mix of residences, privately owned land, and marine-related businesses. The southern tip of the island is owned by the US Navy and is used for military deployment activities. A new general cargo facility is proposed for Radio Island. The new facility would include 2,000 feet of wharf, 300,000 square feet of warehouse space, support buildings, dredging from the Morehead City Channel to the face of the new wharf on Radio Island, and improvements to the road and rail access on Radio Island. The proposed Radio Island project consists of two 1,000-foot berths constructed using a sheet-pile bulkhead. The face of the wharf would be located 700 feet from the near channel line of Morehead City Channel. Dredging will be required between the existing channel and the proposed wharf to allow for the maneuvering and docking of ships at the wharf. Dredging of approximately 37 acres of estuarine bottom to a depth of 45 feet would be required to connect the proposed berths to Morehead City Channel. The construction of the proposed project will require the dredging of approximately 1.7 million cubic yards of dredge material.

Currently the NCSPA has not obtained the necessary authorizations from the Regulatory Division, Wilmington District, USACE (i.e., Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act permits) and the State of North Carolina (i.e., Section 401 Water Quality Certificate, Air Quality permit, Consistency Determination, CAMA permits, etc.) to complete this activity. Moreover, funding for the proposed port expansion has not been approved by the North Carolina State Legislature. No new or existing customer of the port facility has requested to fund this proposed action (Personal Communication, Mr. Todd Walton, Environmental Supervisor, NCSPA, October 19, 2011).

At this time, the NCSPA does not know when or if this expansion project will be completed. Nor does the NCSPA know the specific disposal locations of the approximately 1.7 million cubic yards of dredged material and/or the maintenance interval of the expanded harbor channels. Discussions with representatives from the NCSPA (Personal Communication, Mr. Todd Walton, Environmental Supervisor, NCSPA, October 19, 2011) indicate that the NCSPA are still interested in pursuing this action but they don’t know when or if this will occur.

Figure K-2, below depicts the proposed NCSPA Port Expansion on Radio Island.

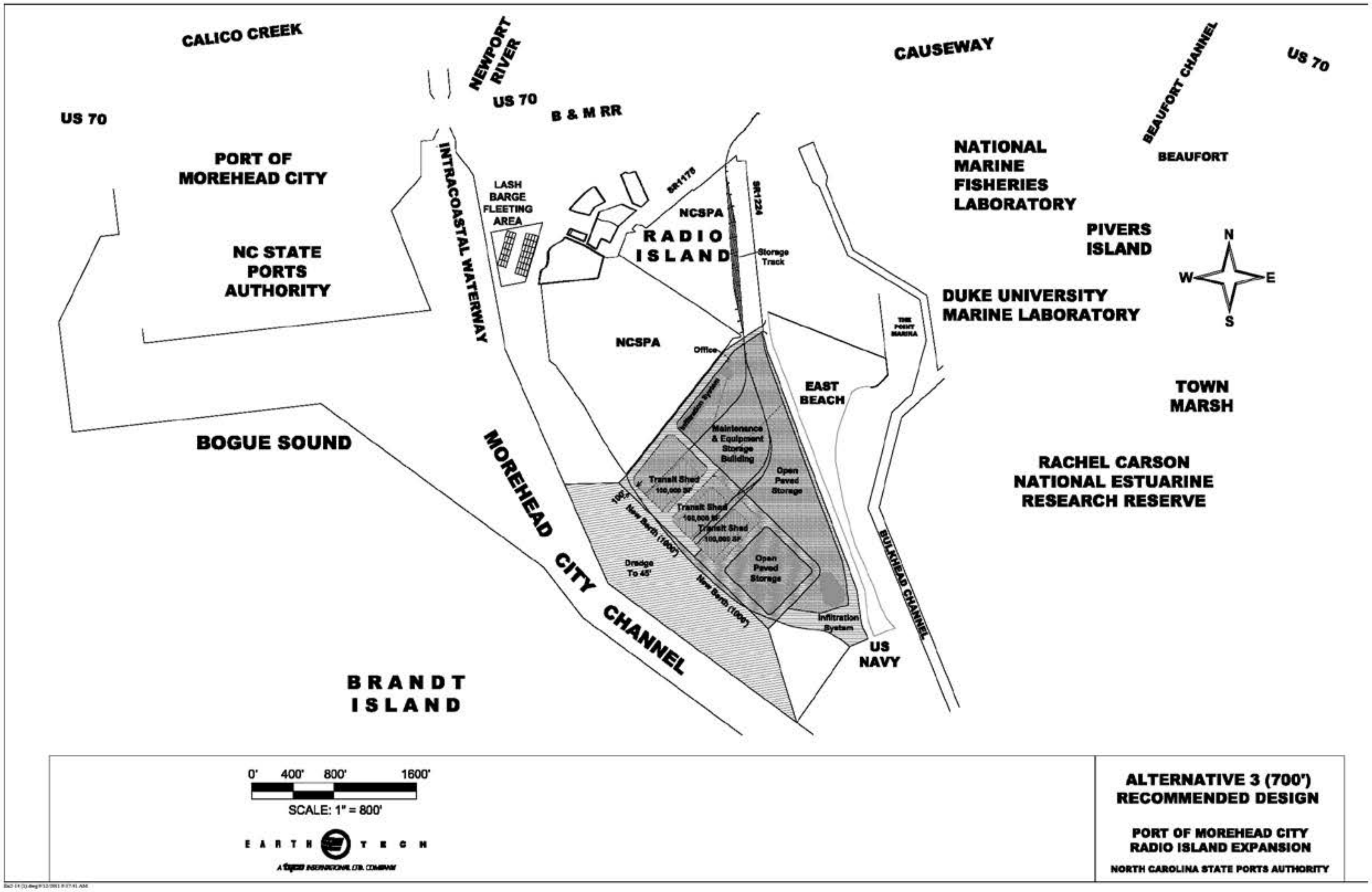

Figure K-2. Proposed NCSPA Port Expansion on Radio Island.

Carteret County's Beach Renourishment plans for Bogue Banks. The following information provides the current status of this project and was taken from Carteret County's Protect the Beach website:

The Bogue Banks Beach Master Nourishment Plan (Master Plan) was formally initiated in 2010. The anticipated completion date for the Master Plan effort (engineering report, environmental document, and final permit decision) is mid 2013.

The Master Plan will evaluate present-day beach conditions, review and reassess the effectiveness of Bogue Banks beach nourishment projects constructed the past decade and develops a new nourishment plan based on volumetric/beach elevation thresholds for Pine Knoll Shores, Indian Beach/Salter Path, and Emerald Isle. Carteret County is assuming Atlantic Beach and Fort Macon's nourishment needs will be met by utilizing dredged material from the Morehead City Harbor Federal Navigation Project. However, Atlantic Beach is included in the overall effort as a contingency wing of the Master Plan and in the spirit of developing a regional nourishment plan. If Federal operation and maintenance funding for the Morehead City Harbor dissipates in the future, then the needs for Atlantic Beach will even be more pressing and again warrant participation in regional planning.

Bogue Banks Carteret County Coastal Storm Damage Reduction Project. The U.S. Army Corps of Engineers',Bogue Banks Coastal Storm Damage Reduction Project is a Civil Works project, which is designed and partially funded by the Corps. It is often referred to as the "50-year project" because the nourishment effort includes initial construction and subsequent periodic maintenance for 50 years. The USACE is currently in the Feasibility Phase (or study phase) of the project

II. Geographic Scope of the Cumulative Impact Assessment

The geographic scope of this Cumulative Impact Assessment will be from Cape Lookout to Cape Fear, a distance of about 115 miles of beaches. The immediate project area is defined as in the vicinity of Bogue and Shackleford Banks. The following numbers are approximate and are used throughout this assessment: Of this 115 miles of beaches, approximately 8% (9 miles) are located within the National Park Service, 10% (11 miles) are within USMC, Camp Lejeune, 11% (12 miles) are State owned, 63% (74 miles) are developed, and 8% (9 miles) are privately owned/developed. Additionally, of the 115 miles of beaches in the geographic scope of this assessment approximately 47% (54 miles) have been designated within the Coastal Barrier Resource System by the USFWS. Table K-4 further discusses these beach classifications.

This analysis will focus on cumulative impacts of the dredged material disposal sites for the Morehead City Harbor DMMP. Figure K-3 shows all of these proposed DMMP sediment disposal areas. The upland diked disposal area on Brandt Island, the approximate 10.5 miles of inlet influenced ocean beach on Bogue Banks (from about Pine Knoll Shores to Fort Macon State Park), the existing 559 acre nearshore placement area off Bogue Banks, and the US EPA approved ODMDS have received dredged sediment in the past. The new or revised disposal/placement areas would be the following:

1. An additional 1,209 acres of nearshore placement area off Bogue Banks (total of 559 existing plus 1,209 or 1,768 acres),

2. A 3.65 miles disposal area within the inlet influenced ocean beach on Shackleford Banks, and

3. A 492 acre nearshore placement area off Shackleford Banks.

The entire 25 miles of Bogue Banks beaches from Emerald Isle to Fort Macon State Park have been previously renourished by the County and/or used as a sediment placement area for the maintenance of the Federal navigation channels in Morehead City Harbor.

Figure K-3. Proposed Disposal Areas for the Morehead City Harbor DMMP.

III. Time Frame

This analysis considers known past, present, and the reasonably foreseeable future, sand placement and/or beach nourishment projects within the geographic scope of the project. The geographic scope is defined from Cape Lookout to Cape Fear or about 115 miles of beaches.

The USACE has maintained the existing federal navigation channels in Morehead City Harbor since 1910. The proposed DMMP addresses dredging needs, disposal capabilities, capacities of disposal areas, environmental compliance requirements, and potential for beneficial use of dredged material and indicators of continued economic justification. This DMMP will ensure sufficient disposal capacity for the 20-year period beginning in 2015 and extending through 2034.

At the project vicinity scale the cumulative assessment considers past periodic beach disposal of Morehead City Harbor maintenance material about every 2 to 3 years along portions of Atlantic Beach and Fort Macon since about 1979. Carteret County has also constructed its own beach nourishment project along Pine Knoll Shores, Salter Path, Indian Beach, and Emerald Isle in 2001/2002 (Phase 1), in 2002/2003 (Phase 2), and in 2003/2004 (Phase 3).

This assessment also includes the one time disposal of maintenance material on Indian Beach, Salter Path, Pine Knoll Shores, Atlantic Beach, and Fort Macon under Section 933 starting in 2003/2004. In the winter of 2007, beach disposal of maintenance material along Pine Knoll Shores under Section 933 was completed.

This assessment assumes continued periodic beach disposal of maintenance material along Fort Macon and Atlantic Beach. Construction of the West Onslow Beach and New River Inlet (Topsail Beach), which are proposed beach nourishment projects. The cumulative analysis also considers the potential that future federal (i.e. Brunswick County Beaches, Bogue Banks, etc.) and non-federal (i.e. Topsail Beach, Bald Head Island, Figure Eight Island, etc.) beach nourishment projects under study could be constructed.

IV. Actions Affecting Resources of Concern

A. Actions Affecting Aquatic Resources.

Dredging the existing Morehead City Harbor Navigation Channel.

Impacts on Nekton. See Section 4.5.1 of the DMMP.

Dredging Impacts. See Section 4.5 of the DMMP.

<u>Entrainment Impacts</u>. See Section 4.5.5 of the DMMP.

Impacts on Benthic organisms. See Section 4.5.3 of the DMMP.

B. Actions Affecting Beach Resources

The Geographic Area considered in this analysis includes Cape Lookout to Cape Fear, about 115 miles of beaches. The major sources of beach impacts are local beach maintenance activities (which include local beach nourishment), disposal of dredged material from maintenance of navigation channels, and beach nourishment (berm and dune construction with long-term periodic maintenance). Of particular concern are macroinvertebrate (section 4.5 of the DMMP), fisheries (section 4.5 of the DMMP), shorebird (section 4.7 of the *DMMP*), and sea turtle species (Section 4.8 and Appendix J of the DMMP) that utilize or occur on or adjacent to ocean beaches. These resources are also impacted by natural events and anthropogenic activities that are unrelated to disposal of sand on the beach as discussed below.

Local Maintenance Activity: Under the existing condition, the 10.5 mile long potential beach disposal area off Bogue Banks is subjected to repeated and frequent maintenance disturbance by individual homeowners and local communities following major storm events. These efforts are primarily made to protect adjacent shoreline property. Such repairs consist of dune rebuilding using sand from beach scraping and/or upland fill. Limited fill and sandbags are generally used to the extent allowable by CAMA permit. Such frequent maintenance efforts could keep the natural resources of the barrier island ecosystems from re-establishing a natural equilibrium with the dynamic coastal forces of the area.

Cape Lookout National Seashore (NPS) does not maintain the existing ocean beach on Shackleford Banks. No dune rebuilding, beach scraping, or installation of sandbags takes place along the beach strand on Shackleford Banks.

Non-Federal Beach Nourishment: Local efforts (i.e., Carteret County) can also include beach nourishment such as that conducted along Pine Knoll Shores, Salter Path, Indian Beach, and Emerald Isle by local interests in 2001-2004. The number of locally funded beach nourishment activities has increased significantly since 2004 along other developed North Carolina beaches. Though non-federal beach nourishment efforts continue to increase, many of these projects are being pursued as one-time interim efforts until the federal beach nourishment projects can be implemented. Therefore, this increase permitted non-federal projects does not necessarily reflect a subsequent increase in resource acreage impacts. Many of the non-federal projects occur within projects which are under study (i.e. Bogue Banks). Beaches that have been nourished under permit, or may be permitted to be nourished, include, but are not limited to: Bogue Banks, North Topsail Beach, Topsail Beach, Figure Eight Island, and Bald Head Island (Table

K-2). Individually, these projects total approximately 47 miles of beach or about 41% (47 miles/115 miles) of North Carolina beaches within the geographic scope of the assessment area. These frequent maintenance efforts could keep the natural resources of the barrier island ecosystems from reestablishing a natural equilibrium with the dynamic coastal forces of the area.

Federal (USACE) Beach Nourishment: Federal beach nourishment activities typically include the construction and long-term (50-year) maintenance of a berm and dune. The degree of cumulative impact would increase proportionally with the total length of beach nourishment project constructed. The first federal North Carolina beach nourishment projects were constructed at Carolina and Wrightsville Beaches in 1965, and totaled approximately 6.4 miles. An additional 3.8 miles of federal beach nourishment project was constructed in 1975 at Kure Beach. Most of the remaining developed North Carolina beaches (including the proposed project area) are currently under study by the Wilmington District for potential future beach nourishment projects (Table K-2). Individually, these existing or proposed federal projects total approximately 51 miles of beach or 44% (51 miles/115 total miles) of North Carolina beaches in the geographic scope of the assessment. Considering all existing and proposed federal and non-federal nourishment projects, and recognizing that some of the projects are overlapping or represent the same project area, approximately 98 miles or 85% (98 miles/115 total beach miles) of the North Carolina coast in the geographic scope could have private or federal beach nourishment projects by 2015.

Table K-2. Summary of federal and non-federal beach nourishment projects in North Carolina (Cape Lookout to Cape Fear) that have recently occurred, are currently underway, or will occur in the reasonably foreseeable future. (This list does not include all small scale beach fill activities (i.e. dune restoration, beach scraping, etc.). (* - federal or non-federal projects which may utilize the same borrow sources and/or overlap beach disposal locations).

Federal / Non-Federal	Project	Source of Sand for Nourishment	Beachfront Nourished	Approximate Length of Shoreline (miles)	Approximate Distance From the MHC DMMP Project Area (miles)
Federal	Cape Lookout National Seashore -East Side of Cape Lookout Lighthouse	Channel	East Side of Cape Lookout Lighthouse	1	10
	*Beaufort Inlet Dredging - Section 933 Project (Outer Harbor)	Beaufort Inlet Outer Harbor	Indian Beach, Salter Path, and Portions of Pine Knoll Shores	7	5
	*Beaufort Inlet and Brandt Island Pumpout - Section 933 (Disposal on Eastern Bogue Banks)	Beaufort Inlet Inner Harbor and Brandt Island Pumpout	Fort Macon and Atlantic Beach	4	0
	*Bogue Banks, NC (Coastal Storm Damage Reduction)	Offshore Borrow Areas	Communities of Bogue Banks	24	5
	Surf City and North Topsail Beach - (Coastal Storm Damage Reduction)	Offshore Borrow Areas	Surf City and North Topsail Beach	10	40
	*West Onslow Beach New River Inlet (Topsail Beach) (Coastal Storm Damage Reduction)	Offshore Borrow Areas	Topsail Beach	6	50
	Wrightsville Beach (Coastal Storm Damage Reduction)	Masonboro Inlet and Banks Channel	Wrightsville Beach	3	80
	Carolina Beach and Vicinity, NC Carolina Beach Portion (Coastal Storm Damage Reduction)	Carolina Beach Inlet	Carolina Beach	2	85
	Carolina Beach and Vicinity, NC Kure Beach Portion (Coastal Storm Damage Reduction)	Wilmington Harbor Confined Disposal Area 4 and an Offshore Borrow Area	Kure Beach	2	85
Non-Federal	*Emerald Isle FEMA Project	Offshore Borrow Areas - Morehead City Port Shipping Channel (ODMDS)	Emerald Isle	4	10
	*Bogue Banks FEMA Project	Offshore Borrow Areas – Morehead City Port Shipping Channel (ODMDS)	Emerald Isle (2 segments), Indian Beach, Salter Path, Pine Knoll Shores	13	5
	*Bogue Banks Restoration Project – Phase I – Pine Knoll Shores and Indian Beach Joint Restoration	Offshore Borrow Areas	Pine Knoll Shores and Indian Beach	7	10
	*Bogue Banks Restoration Project – Phase II – Eastern Emerald Isle	Offshore Borrow Areas	Indian Beach and Emerald Isle	6	20
	*Bogue Banks Restoration Project – Phase III– Bogue Inlet Channel Realignment Project	Bogue Inlet Channel	Western Emerald Isle	5	15
	*North Topsail Dune Restoration (Town of North Topsail Beach)	Upland borrow source near Town of Wallace, NC	North Topsail Beach	NA	40
	*North Topsail Beach Shoreline Protection Project	New River Inlet Realignment and Offshore Borrow Area	North Topsail Beach	11	40
	*Topsail Beach - Beach Nourishment Project	New Topsail Inlet Ebb Shoal and Offshore Borrow areas	Topsail Beach	6	40
	Figure Eight Island	Banks Channel and Nixon Channel	North & South Sections of Figure Eight Island	3	70
	Rich Inlet Management Project	Relocation of Rich Inlet	Figure Eight Island	NA	60
	Mason Inlet Relocation Project	Mason Inlet (new channel) and Mason Creek	North end of Wrightsville Beach and south end of Figure Eight Island	2	65

Federal (USACE) Navigation Channel Disposal of Dredged Material: Maintenance material from dredging in the vicinity of Morehead City Harbor has historically been disposed along about 6 miles of beach including the Town of Atlantic Beach and Fort Macon. Throughout the geographic scope of this assessment, a total of approximately 17 miles of beach or about 15% or (17 miles/115 total miles) of North Carolina beaches are authorized for disposal of beach quality dredged material from maintenance dredging of navigation channels (see Table K-3). However, not all of these projects are routinely dredged and a majority of the authorized disposal limits are not actually disposed on to the full extent. Additionally, many of the authorized placement/disposal limits overlap with existing federal or non-federal beach projects. The USACE currently uses up to about 50 percent of the length of beach in North Carolina that is approved for this purpose and does not anticipate significant increases in beach disposal in the foreseeable future.

Table K-3 Summary of dredged material disposal activities on North Carolina (Cape Lookout to Cape Fear) ocean front beaches associated with navigation dredging. Projects listed and associated disposal locations and quantities may not be all encompassing and represent an estimate of navigation disposal activities for the purposes of this cumulative impacts assessment. (* - Navigation disposal sites which may overlap with existing Federal or Non-Federal beach nourishment projects).

PROJECT		DISPOSAL LOCATION	APPROVED DISPOSAL LIMITS	ESTIMATED ACTUAL DISPOSAL LIMITS	ESTIMATED QUANTITY (CY)	COMMENTS
Beaufort	***Morehead City (Brandt Island)**	2,000 ft west of inlet, Fort Macon and Atlantic Beach to Coral Bay Club, Pine Knoll Shores	7.3 miles (38,300 lf)	5.2 miles or 27,800 linear feet	3.5 million every 8 yrs	Material from Ocean Bar routinely placed in nearshore berm or ODMDS on annual basis
	***AIWW Section I, Tangent B**	Pine Knoll Shores, vicinity of Coral Bay	2 miles (10,500 lf)	0.4 miles or 2,000 linear feet	<50,000 every 5 yrs	This area is included every 8 years as part of the pumpout for Brandt Island. Also included in the area under investigation for beach nourishment at Bogue Banks.
Swansboro	***AIWW Bogue Inlet Crossing Section I, Tangent-H through F**	Approx. 2,000 feet from inlet going east to Emerald Point Villas, Emerald Isle (Bogue Banks)	1mile (5,280 lf)	0.4 miles or 2,000 linear feet	<100,000 annually	
Browns Inlet	**AIWW Section II, Tangents-F,G,H**	Camp Lejeune, 3,000 feet west of Browns Inlet extending westward	1.58 miles (6,000 lf)	1 mile or 5,280 linear feet	<200,000 every 2 yrs	
New River Inlet	***AIWW, New River Inlet Crossing Section II, Tangents I & J, Channel to Jax. Section III, tangents 1&2**	N. Topsail Beach, 3,000 feet west of inlet extending westward to Maritime Way (Galleon Bay area)	1.5 miles (8,000 lf)	0.8 miles or 4,000 linear feet	<200,000 annually	Two areas 2,000 linear feet on either side of disposal area are routinely used.
Hampstead	***AIWW, Sect. III**	Topsail Island, Queens Grant	0.6 miles (2,500 lf)	0.6 miles or 2,500 lf	<50,000 every 6 yrs	
	***AIWW, Topsail Inlet Crossing & Topsail Creek**	Topsail Beach, from a point 2,000 feet north of Topsail Inlet	1 mile (5,280 lf)	0.4 mi or 2,000 ft	<75,000 annually	
Wrightsville Beach	**AIWW Sect. III,Tang 11&12 Mason Inlet Crossing**	Shell Island (north end of Wrightsville Beach from a point 2,000 feet from Mason Inlet	0.4 miles (2,000 lf)	0.4 mi. or 2,000 lf	<100,000	Not recently required since the inlet crossing closed up. If reopened will be rescheduled if needed
	***Masonboro Sand Bypassing**	At a point 9,000 feet from jetty extending southward midway of island	1.2 miles (6,000 lf)	1 mile 5,280 lf	500,000 every 4 years	Same time as Wrightsville Beach Nourishment
Carolina Beach	**AIWW, Section IV, Tangent 1**	Southern end of Masonboro Island at a point 2,000 linear feet from Carolina Beach Inlet extending northward to Johns Bay area	1.3 miles (7,000 lf)	0.4 miles (2,000 linear feet)	<50,000 annually	This site is used alternately with Carolina Beach disposal Site on North end of Island
Bald Head	***Bald Head**	Beach front on eastern and western shoreline	3.0 miles (16,000 lf)	3.0 miles or 16,000 lf	1.1 million every 2 years (except every 6th when it goes to Caswell)	Least Costly Disposal Option From Wilmington Harbor Ocean Bar Project.

Beach quality sand is a valuable resource that is highly sought by beach communities to provide wide beaches for recreation and tourism, as well as to provide hurricane and wave protection for public and private property in these communities.

When beach quality sand is dredged from navigation projects, it has become common practice of the USACE to make this resource available to beach communities, to the maximum extent practicable. Disposal of this sand on beaches represents return of material, which eroded from these beaches, and is, therefore, replenishment with native material. The design of beach disposal sites generally extends the elevation of the natural berm seaward.

Other factors affecting Beach Resources: Many factors unrelated to disposal of sand on the beach may affect beach resources including: benthic invertebrate resources, shorebird populations, and ocean fish stocks. The factors can be a result of natural events such as natural population cycles or as a result of favorable or negative weather conditions including droughts, floods, La Niña, El Niño, and major storms or hurricanes to name a few. A primary anthropogenic factor affecting shorebird populations is beach development resulting in a loss or disturbance of nesting habitat and invasion of domestic predators. Primary man-induced factors affecting fish stocks are over fishing and degradation of water quality due to pollution.

V. Significant Resources and Impacts

Based on scoping comments from resource agencies and others, the primary concerns with the proposed maintenance dredging and beach disposal are direct and indirect impacts to hard bottom communities, macro-invertebrates, fish, shorebirds, and sea turtles. Federally listed threatened or endangered species which could be present along the North Carolina coast are the blue whale, finback whale, humpback whale, North Atlantic right whale, sei whale, sperm whale, West Indian manatee, green sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, loggerhead sea turtle, Atlantic sturgeon, shortnose sturgeon, seabeach amaranth, and piping plover. Impacts to all Federally listed protected species are provided in Appendix J Biological Assessment and summarized below and include, but are not limited to, mortality, reduction in prey species, habitat change, and disturbance during construction activities. Also discussed are the benefits of periodic disposalbeach disposals/renourishments, which are expected to enhance nesting habitat of sea turtles and to provide additional habitat for sea beach amaranth. Detailed discussions of all significant resources and associated impacts considered in this assessment for Bogue and Shackleford Banks are included in Sections 4.0 and 5.0 of the DMMP .

Beach and Dune. Terrestrial habitat types within these areas include sandy or sparsely vegetated beaches and vegetated dune communities. Mammals occurring within this environment are opossums, cottontails, gray foxes, raccoons, feral house cats, shrews, moles, voles, and house mice. Common vegetation of the upper beach includes beach spurge, sea rocket and pennywort. The dunes are more heavily vegetated, and common species include American beach grass, panic grass, sea oats, broom straw, seashore elder, and salt meadow hay. Seabeach amaranth, a federally listed threatened species, is present throughout most of North Carolina. Ghost crabs are important invertebrates of the beach/dune community. The beach and dune also provide important nesting habitat for loggerhead and green sea turtles as well as habitat for a number of shorebirds and many other birds, including resident and migratory songbirds. Disposal of material along the ocean beach enhances and improves important habitat for a variety of plants and animals, and restores lost habitat in the areas of most severe erosion. This is especially important for nesting loggerhead sea turtles and seabeach amaranth. Historic nesting data from Bogue Banks indicate that sea turtles continue to nest on disposal beaches with hatch rate successes similar to non-disposal beaches (Matthew Godfrey, Personal Communication 2010). Furthermore, new populations of seabeach amaranth have been observed to follow sand disposal on beaches where sand has been disposed by the USACE (i.e., Wrightsville Beach and Bogue Banks) (USFWS 1996b; CSA 2002).

In addition to providing important upland habitat, the cumulative effects of beach disposal projects in Bogue and Shackleford Banks is not significant and would protect public infrastructure, public and private property, and human lives.

Marine Waters (including Nearshore Placement Areas). Along the coast of North Carolina, marine waters provide habitat for a variety of ocean fish and are important commercial and recreational fishing grounds. Kingfish, spot, bluefish, weakfish, spotted sea trout, flounder, red drum, king mackerel, and Spanish mackerel are actively fished from boats, the beach, and local piers. Offshore marine waters serve as habitat for the spawning of many estuarine dependent species. Oceanic large nekton located offshore of North Carolina are composed of a wide variety of bony fishes, sharks, and rays, as well as fewer numbers of marine mammals and reptiles. Marine mammals and sea turtles that may be present are addressed in Appendix J Biological Assessment. Dredging and placement of beach/nearshore fill may create impacts in the marine water column in the immediate vicinity of the activity, potentially affecting the surf zone and nearshore ocean. These impacts may include minor and short-term suspended sediment plumes and related turbidity, as well as the release of soluble trace constituents from the sediment. Overall water quality impacts for any given project are expected to be short-term and minor.

Cumulative effects of multiple simultaneous beach and nearshore placement operations in the Bogue and Shackleford Banks could potentially impact fishes of the surf zone. However, the frequency of beach and nearshore placement (on average once every three years), the high quality of the sediment selected for beach fill and the small amount of beach affected at any point in time would not suggest that this activity poses a significant threat.

The frequency of use for the nearshore placement areas off Bogue and Shackleford Banks are in years 2 and 3 of the DMMP cycle, the Corps will ensure that the same placement locations are used time after time, No hardbottoms are located within these nearshore placement areas (see Section 5.5.6 in the DMMP). Additionally, by placing sediment on the beaches and nearshore areas of Bogue and Shackleford Banks, the deflation of the Beaufort Inlet Ebb Tide Delta will be reduced.

Therefore the use of the beach and nearshore placement areas off Bogue and Shackleford Banks will not cause a significant cumulative impact to the marine fauna.

Intertidal and Nearshore Zones. The intertidal zone within the proposed beach nourishment areas serves as habitat for invertebrates including mole crabs, coquina clams, amphipods, isopods, and polychaetes, which are adapted to the high energy, sandy beach environment. These species are not commercially important; however, they provide an important food source for surf-feeding fish and shore birds. The surf zone is suggested to be an important migratory area for larval/juvenile fish moving in and out of inlets and estuarine nurseries (Hackney et al. 1996). Disposal operations along the beach can result in increased turbidity and mortality of intertidal macrofauna, which serves as food sources for various fish and bird species. Therefore, feeding activities of these species may be interrupted in the immediate area of beach sand placement. These mobile species are expected to temporarily relocate to other areas as the project proceeds along the beach. Though a short-term reduction in prey availability may occur in the immediate disposal area, only a small area is impacted at any given time, and once complete, organisms can recruit into the nourished area. The anticipated construction timeframes for pipeline beach projects on Bogue Banks would be from November 16 to April 30 and on Shackleford Banks from November 16 to March 31 for pipeline dredges and hopper dredge projects would be from January 1 to March 31 and would avoid a majority of the peak recruitment and abundance time period of surf zone fishes and their benthic invertebrate prey source. To summarize, the impacts of beach/nearshore placement projects on the intertidal and nearshore zones are considered temporary, minor and reversible.

Cumulative effects of multiple simultaneous beach/nearshore placement operations in the Bogue and Shackleford Banks could be potentially harmful to benthic invertebrates in the surf zone; however, the frequency of sediment disposal on the beach (on average once every three years), the high quality of the sediment selected for beach fill and the small amount of beach affected at any point in time would suggest that this activity would not pose a significant threat.

The frequency of use for the nearshore placement areas off Bogue and Shackleford Banks are in years 2 and 3 of the DMMP cycle. No hardbottoms are located within these nearshore placement areas (see Section 5.5.6 in the DMMP). Additional benefits would be placement of sediment within the littoral zone could reduce the deflation of the Beaufort Inlet Ebb Tide Delta.

Therefore the use of the beach and nearshore placement areas off Bogue and Shackleford Banks will not cause a significant cumulative impact to the benthic macrofauna.

Hardbottoms. Of special concern in the offshore area are hard bottoms, which are localized areas, not covered by unconsolidated sediments and where the ocean floor is hard rock (see Sections 4.5.06 and 5.5.06 of the DMMP). Hard bottoms are also called "live bottoms" because they support a rich diversity of invertebrates such as corals, anemones, and sponges, which are refuges for fish and other marine life. They provide valuable habitat for reef fish such as black sea bass, red porgy, and groupers. Hard bottoms are also attractive to pelagic species such as king mackerel, amberjack, and cobia. Along the North Carolina coast, hard bottoms are most abundant in southern portion of the state. Review of data provided by the Southeast Monitoring and Assessment Program (SEAMAP 2001) and the results of surveys from Tidewater and Geo-Dynamics identified one area of hard bottom off Pine Knoll Shores, about 2 miles south of the project area.

Additional side-scan sonar surveys within the proposed Shackleford Banks nearshore and the proposed expanded Nearshore West revealed no evidence of hard bottoms. (USACE 2010a). This remote-sensing data confirms that proposed material placement at the sites will not have any impact on exposed hard bottoms or associated marine life.

Therefore the cumulative effects on hard bottoms from disposal of beach compatible sediment on the beaches and nearshore areas of Bogue and Shackleford Banks is not significant since there is no evidence of any hard bottoms in the project area.

Nearshore Zone. Maintenance sediment (80% or greater sand) is also to be placed in the nearshore areas off Bogue and Shackleford Banks. Benthic organisms, phytoplankton, and seaweeds are the major primary producers in this community with species of *Ulva* (sea lettuce), *Fucus*, and *Cladocera* (water fleas) being fairly common where suitable habitat occurs. Many species of fish-eating birds are typically found in this area including gulls, terns, cormorants, loons, and grebes (Sections 4.7 and 5.7). Marine mammals and sea turtles also are frequently seen in this area and are discussed in detail in Sections 4.8 and 5.8, and in Appendix J Biological Assessment of the DMMP. Fishes and benthic resources of this area are discussed in Sections 4.5 and 5.5 of the DMMP, respectively.

Cumulative effects of multiple simultaneous nearshore placement operations in Bogue and Shackleford Banks could be potentially harmful to benthic invertebrates in the nearshore area. No hardbottoms are located within these nearshore placement areas (see Section 5.5.6 in the DMMP). and the small amount of nearshore area affected at any point in time would suggest that this activity would not pose a significant threat. Additional benefits would be placement of sediment within the littoral zone could reduce the deflation of the Beaufort Inlet Ebb Tide Delta. Therefore, the cumulative effect of placement of sediment (80% or greater sand) in the nearshore areas off Bogue and Shackleford Banks is not significant.

Other Resources and Impacts

Air Quality. The ambient air quality for all of coastal North Carolina has been determined to be in compliance with the National Ambient Air Quality Standards. All coastal counties in North Carolina are designated as attainment areas and do not require conformity determinations.

Additionally, although ozone is not a significant problem in the coastal counties, ozone is North Carolina's most widespread air quality problem, particularly during the warmer months. High ozone levels generally occur on hot sunny days with little wind, when pollutants such as nitrogen oxides and hydrocarbons react in the air. The ozone season is April through October. Dredging with beach disposal or renourishment typically takes place during the cooler months of the year, during times of low biological activity and outside of the ozone season.

The project is not anticipated to create any adverse cumulative effect on the ambient air quality of this attainment area.

Social and Economic. The coastal areas of North Carolina will continue to grow and expand both with and without the Morehead City Harbor DMMP. Therefore, the economic benefit analysis for the proposed project claims no increase in benefits or hurricane and storm damage due to induced development. Development of vacant lots in Bogue Banks is limited to lots buildable under the regulations set forth by CAMA, flood plain regulations, State and local ordinances, and applicable requirements of the Federal Flood Insurance Program.

The proposed DMMP is not anticipated to create any adverse cumulative social or economic impacts. Continued maintenance of the Morehead City Harbor will provide cumulative social and economic benefits to the project area.

Wave Conditions. Placement of sediment in the nearshore areas off Bogue and Shackleford Banks is the only potential source of impacts on wave conditions. However, these changes are not expected to be significant considering the shallow nature of the proposed placement sites.

No adverse cumulative impacts are anticipated on wave conditions in the project area.

Shoreline and Sand Transport. On Bogue Banks, the 10.5 mile long placement area (from Fort Macon State Park to Pine Knoll Shores) is located within the Beaufort Inlet influence area and there is a net transport to the east. On Shackleford Banks, the 3.65 mile long disposal area is also located within the inlet influence area and the net sand drift is to the west. Both nearshore placement areas off Bogue and Shackleford Banks are located within the Beaufort Inlet influence area.

Additional information on the dynamics of the inlet and ebb tide delta is found in the Coastal Engineering Section of the DMMP. On a regional basis, placement of maintenance sediment within the inlet influence area adds material to the longshore transport system, thus providing positive impacts to the Beaufort Inlet ebb tide delta. Although a regional sediment budget analysis has not been completed, it is expected that the proposed action and the combined effects of all other existing and proposed beach projects will have a minimal effect on shoreline and sand transport.

Therefore no adverse cumulative impacts on the shoreline and sand transport in the project area are expected.

VI. Resource Capacity to Withstand Stress and Regulatory Thresholds

There are no known thresholds relating to the extent of ocean bottom that can be disturbed without significant population level impacts to fisheries and benthic species. Therefore, a comparison of cumulative impacts to established thresholds is not made. However, the potential nearshore placement area off Bogue and Shackleford Banks impact area of the proposed project is small relative to the area of available similar habitat on a local, vicinity, and statewide basis and the quick recovery rate of opportunistic species. It is expected that there is a low risk that the direct and cumulative impacts of the proposed action and other known similar activities would reach a threshold with potential for population level impacts on important commercial fish stocks. In regard to physical habitat alterations in the placement areas, it is expected that alterations in depths and bottom sediment may occur and be persistent. However, site modifications would be within the range of tolerance by these species and, although man-altered, consistent with natural variations in depth and sediment within the geographic range of EFH for local commercial fish species.

In a 1999 Environmental Report on the use of federal offshore sand resources for beach and coastal restoration, the U.S. Department of Interior, Minerals Management Service (DOI 1999) provided the following assessment of potential impacts to beach fauna from beach disposal:

Because benthic organisms living in beach habitats are adapted to living in high energy environments, they are able to quickly recover to original levels following beach nourishment events; sometimes in as little as three months (Van Dolah et al. 1994; Levison and Van Dolah 1996). This is again attributed to the fact that intertidal organisms are living in high energy habitats where disturbances are common. Because of a lower diversity of species compared to other intertidal and shallow subtidal habitats (Hackney et al. 1996), the vast majority of beach habitats are recolonized by the same species that existed before nourishment (Van Dolah et al. 1992; Nelson 1985; Levison and Van Dolah 1996; Hackney et al. 1996).

While the proposed beach disposal may adversely impact benthic macrofauna, these organisms are highly resilient and any effects will be localized, short-term, and reversible.

VII*. Baseline Conditions*

The following DMMP section describes the status of significant resources that may be affected by this and other similar projects that are pertinent to this analysis.

Section 4.0, Affected Environment.

VIII. *Cause and Effect Relationships*

The following DMMP section describes impacts of the proposed action on significant resources. Cause and effect relationships described in the report are consistent with those that would be expected for other similar projects that are pertinent to this analysis.

Section 5.0, Environmental Effects.

IX. Magnitude and Significance of Resource Impacts

A. Morehead City Harbor Federal Navigation Channel

The USACE has maintained the Morehead City Harbor Federal navigation channel since 1910. Over time the harbor channels have been deepened and widened to their current dimensions. Actions associated with maintenance of the Morehead City Harbor have been addressed in a number of environmental and planning reports which describe the Morehead City Harbor federal navigation project, its ongoing and proposed improvements, the details of dredging and disposal operations required for its construction and maintenance, and the environmental aspects of the project (see Section 1.5 Incorporation by Reference of the DMMP). The Morehead City Harbor DMMP is not planning to deepen or widened the harbor channels but to ensure that the dredge maintenance sediment is placed within the inlet influence area which would add material to the longshore transport system, thus providing positive impacts to the Beaufort Inlet Ebb Tide Delta.

In 2010, the point of the spit on the west end of Shackleford Banks had accreted toward the navigation channel and had encroached upon the authorized channel. The Morehead City Harbor channel is a fixed channel that cannot be realigned without additional physical and environmental impact analyses and additional approvals Therefore, in order to maintain safe navigation of the authorized channel, dredging of approximately 1 acre of the upland portion of the spit was imminent (Figure 1). However, in August 2011, Hurricane Irene struck the project area and drastically changed the configuration of the spit. Aerial photography and recent hydrographic surveys indicate that the upland portion of the spit no longer encroaches into the navigation channel.

Over time, the spit on the west end of Shackleford Banks may accrete and return to a position that encroaches on the navigation channel. If so, maintenance dredging of the channel could affect upland portions of the spit. Prior to any dredging of the spit, the USACE would complete a separate NEPA document to address environmental effects. During the NEPA process, the USACE would coordinate with applicable resource agencies, including coordination with USFWS regarding potential impacts to the threatened Piping Plover and its designated critical wintering habitat, as well as coordination with the NPS to obtain the required Special Use Permit.

Site Specific Impacts:
Cumulative impacts from space crowded perturbations could occur at the local scale resulting from the periodic maintenance and sediment disposal activities of the Morehead City Harbor DMMP and Bogue Banks federal and non-federal projects.

Geographic Area Impacts:

Existing and Potential Sites: Beach compatible sediment identified for all federal and non-federal nourishment projects throughout the geographic area (from Cape Lookout to Cape Fear) is most often identified from: maintenance or deepening of navigation channels, and/or offshore borrow areas (Table K-2). For the purposes of this impact assessment, only beach and nearshore placement areas are evaluated for cumulative marine resource impacts.

Considering only the projects that are currently in use (Table K-3), significant cumulative impacts associated with time and space crowded perturbations are not expected considering that these sediment disposal areas are spread throughout the state and the acreage of impact for these disposal areas relative to the available un-impacted sites throughout the state is not significant. However, recognizing the potential for all of the federal projects identified in the geographic area (from Cape Lookout to Cape Fear) to occur within the reasonably foreseeable future (Table K-3), there is a potential for cumulative impacts for time and space crowded perturbations associated with the cyclic use of the disposal areas.

B. Beach Areas

The impacts of beach disposal on Bogue and Shackleford Banks beaches are evaluated in Section 5 of the DMMP. The degree of cumulative impact would increase proportionally with the total length of beach impacted. The most likely projects to increase the length of North Carolina beach disposal are beach nourishment projects.

As shown in Table K-4 below, the North Carolina Ocean beaches (geographic scope of the assessment is from Cape Lookout to Cape Fear, about 115 miles of beaches) can be divided up based on the potential that a beach nourishment project will be proposed for them. The Coastal Area Management Act (CAMA) applies to all 20 North Carolina Coastal Counties. Proper beach nourishment , dredged material disposal, and/or local maintenance within these counties is generally regulated under CAMA and/or USACE permitting authorities alone, and for this analysis, are labeled CAMA regulated. Approximately 63 percent of North Carolina beaches are in this category. Other North Carolina ocean beach areas which are less likely to be considered for beach disposal include those identified under the Coastal Barrier Resources Act (CBRA) of 1982 (PL 9-348), the Coastal Barrier Improvement Act of 1990 (PL 101-591), and National and State park lands. CBRA restricts federal expenditures in those areas comprising the Coastal Barrier Resources System (CBRS); thus, long term federal beach nourishment projects will not occur in defined CBRA zones. However, though long term federal beach nourishment projects are restricted from CBRA zones, non-federal permitted projects may still occur (i.e. North Topsail Beach) on a short term basis. National or state park lands are the least likely to have beach disposal projects considering that their mission is often to manage lands in their natural state and protection of infrastructure is less common. However, the National Park Service, Cape Lookout National Seashore has requested that the USACE place 90% or greater sand on a 3.65 mile disposal site on Shackleford Banks. National and state parks allow highly restricted placement under special use permits and conduct disposal only as required to protect resources, such as at Pea Island (1.5 miles) and now Shackleford Banks (3.65 miles). Only about 8 percent (9 miles /115 total miles) of beach disposal areas within the geographic scope of the cumulative assessment are designated as National Park Lands.

Beach Classification	Percentage of NC Beaches	Potential for Beach Disposal/Nourishment Activities
Coastal Barrier Resource System	47	Medium
Developed and/or CAMA Regulated	63	High
National Park Lands	8	Low
State Park Lands	11	Low

Table K-4. North Carolina beach classifications and associated potential for beach disposal/nourishment activities from Cape Lookout to Cape Fear (115 miles of beaches). Note: the percentage of NC Beach Classifications is greater than 100% since some of the beaches have multiple designations (i.e., some developed areas have been designated within the Coastal Barrier System).

X. Summary of Impacts within the Geographic Scope of the Cumulative Assessment

The following quantitative analyses of the geographic scope (Cape Lookout to Cape Fear) impacts were determined based on data provided in Tables K-2 and K-3. These data represent an estimate of the percent of North Carolina beach affected by sand disposal for maintenance of federal navigation channels, and existing, proposed, or potential federal and non-federal beach nourishment projects. Table K-5 represents the total project miles for all existing and proposed federal and non-federal beach nourishment projects and the full authorized limits for beach disposal of navigation dredged material. However, assuming all of these activities were constructed to the full extent (which is very unlikely considering funding constraints, dredging needs from navigation channels, etc.) these estimates would not represent the actual extent of North Carolina ocean beach impacted because of overlapping project areas.

Project Type	Total Project Miles	% NC Beach
Federal Beach Nourishment	51	44
Non-Federal Beach Nourishment	47	41
Federal Authorized Beach Placementl	17	15
TOTAL	**115**	**100**

Table K-5. Summary of total project miles from Cape Lookout to Cape Fear (115 miles of beaches) for existing and/or proposed federal and non-federal nourishment activities and disposal of dredged material.

Recognizing that many of the existing or proposed federal and non-federal beach nourishment project limits overlap and that some portions of the federal authorized beach disposal limits are within these project areas as well, Table K-6 provides an estimate of total mileage of North Carolina Ocean beach from Cape Lookout to Cape Fear (about 115 miles of beach) that could cumulatively be impacted by beach nourishment or navigation disposal activities without double counting the overlapping projects.

Project Type	Total Miles Impacted (*w/o double counting for overlaping projects)	% NC Beach
Federal and Non-Federal Beach Nourishment	98	85
Federal Authorized Beach Disposal	17	15
TOTAL	115	100

Table K-6. Summary of cumulative mileage of North Carolina Ocean beach from Cape Lookout to Cape Fear (115 miles of beaches) that could be impacted by beach nourishment and/or navigation disposal activities.

A. Federally Authorized Beach disposal:

17 miles or 15 percent of the North Carolina ocean beaches from Cape Lookout to Cape Fear are Federally authorized for beach disposal (see Table K-6) from Cape Lookout to Cape Fear. However, not all of these projects are routinely dredged and a majority of the authorized beach disposal limits are not actually disposed on to the full extent. Additionally, many of the authorized placement/disposal limits overlap with existing federal or non-federal beach projects. The USACE currently uses up to about 50 percent of the length of

beach in North Carolina that is approved for this purpose and does not anticipate significant increases in beach disposal in the foreseeable future.

B. Existing Beach Nourishment:

Of the total 98 miles of potential federal and non-federal beach nourishment project miles proposed for NC ocean beaches from Cape Lookout to Cape Fear (Table K-5), a total of 34 miles (29%) have actually been constructed. However, this estimate represents actual project miles nourished and does not reflect circumstances where the projects overlap. Therefore, the total number of actual miles of beach nourished is less.

C. Cumulative Impacts:

Considering all proposed and existing disposal and nourishment impacts throughout the geographic area (from Cape Lookout to Cape Fear), a significant portion of the shoreline will have beach disposal activities in the foreseeable future, likely resulting in time and space crowded perturbations. However, recognizing the funding constraints to complete all authorized and/or permitted activities, the availability of dredging equipment, etc.; it is very unlikely that all of these proposed projects would ever be constructed all at once. Therefore, though time and space crowded perturbations are expected in the reasonably foreseeable future, assuming each project adheres to project related impact avoidance measures, it is likely that adjacent un-impacted and/or recovered portions of beach will be available to support dependent species (i.e. surf zone fish, shore birds, etc.) and facilitate recovery of individual project sites to pre-project conditions.

XI. Project Level Impacts Within the Project Vicinity on Bogue and Shackleford Banks

Bogue Banks: The proposed DMMP may impact about 10.5 miles of shoreline from Fort Macon State Park to Pine Knoll Shores. An additional 1,209 acres of nearshore placement area off Bogue Banks (total of 559 existing acres plus 1,209 or 1,768 acres) is included in the DMMP.

Shackleford Banks: The DMMP proposes to impact (for the first time) a new beach disposal area within a 3.65-mile portion of the ocean beach on Shackleford Banks and a new nearshore placement area (Nearshore East) that is 492 acres.

A. Existing Local Maintenance:

Under existing conditions, the entire study area on Bogue Banks (10.5 miles) is expected to experience frequent local maintenance, including beach scraping, bulldozing, dune restoration, beach restoration, etc. No existing local maintenance is expected by the NPS on Shackleford Banks.

B. Existing Disposal Activities:

Annual navigation disposal activities (up to about 700,000 cy) may occur from the Fort Macon State Park to Atlantic Beach.

The disposal of beach nourishment material along the 10.5-mile study area on Bogue Banks is not expected to affect the current disposal schedule.

No existing disposal activities exist on Shackleford Banks.

C. Existing Beach Nourishment:

None on Shackleford Banks. Carteret County is planning to complete the Bogue Banks Beach Master Nourishment Plan (Master Plan). The County retained Moffatt & Nichol to develop a comprehensive, multi-decadal nourishment program using objective parameters to gauge beach health and trigger future nourishment events for the entire 24-mile long island of Bogue Banks.

D. Proposed Beach Nourishment:

The entire 10.5-mile federal study area is located within the Corp's Bogue Banks Feasibility Study proposed for beach disposal. Additionally, this same 10.5 mile long disposal area is proposed to be nourished by the County's (non-Federal study) Bogue Banks Beach Master Nourishment Plan (Master Plan).

E. Cumulative Impacts (Within the Project Vicinity on Bogue and Shackleford Banks):

Bogue Banks: The currently approved 10.5 mile long beach navigation disposal area is located within the proposed project area study area. Therefore, all of the existing 10.5 mile beach disposal area has had previous used as a beach disposal area. For areas that have had local disturbances (i.e. beach bulldozing), it is possible that the proposed action will impact beach invertebrates in areas that have not fully recovered from past sand deposition, extending recovery time.

Shackleford Banks: The currently proposed 3.65 mile long beach navigation disposal area has not been used as a navigation material deposition site. The NPS does not plan any local disturbances (i.e. beach bulldozing) on this site.

Conclusion

Historically, the extent of beach disposal/nourishment activities on beaches within the geographic area from Cape Lookout to Cape Fear was limited to a few authorized federal projects including: Wrightsville Beach, Carolina and Kure Beaches. However, in the past 10 years, a significant number of federal and non-federal beach nourishment efforts were pursued to provide coastal storm damage reduction along the increasingly developed North Carolina shoreline. Additionally, the number of non-federal permitted beach nourishment projects has increased in recent years in efforts to initiate coastal storm damage reduction measures in the interim of federal projects being authorized and/or funded (i.e. North Topsail Beach, and Topsail Beach, and Bogue Banks). Furthermore, the frequency of beach disposal activities for protection of infrastructure will continue throughout the state resulting in cumulative time and space crowded perturbations. However, assuming projects continue to adhere to environmental commitments for the reduction of environmental impacts, and un-developed beaches throughout the state continue to remain undisturbed, it is likely that adjacent un-impacted and/or recovered portions of beach will be available to support dependent species (i.e. surf zone fish, shore birds, etc.) and facilitate recovery of individual project sites to pre-project conditions.

Assuming recovery of impacted beaches and the sustainability of un-developed protected beaches (i.e. National/Federal and State Parks and Estuarine Reserves) the potential impact area from the proposed DMMP on Bogue and Shackleford Banks as well as existing actions is small relative to the area of available similar habitat on a vicinity and statewide basis.

The DMMP is proposing to place only coarse grain material (i.e., 90% or greater sand) on 3.65 miles ocean beach on Shackleford Banks, which has never been designated as a disposal area. The proposed DMMP represents an approximate increase of only 3.1% (3.65 miles/115 miles) in the area of North Carolina beaches affected by sand disposal. Therefore the DMMP will not significantly increase cumulative impacts in the immediate project area or within the geographic scope of the cumulative assessment.

XII. Actions to Reduce Cumulative Impacts

The proposed DMMP will reduce cumulative impacts in the project area or within the geographic scope of the cumulative assessment by the following actions:

1. By placing sediment on the beaches and nearshore areas of Bogue and Shackleford Banks, the deflation of the Beaufort Inlet Ebb Tide Delta will be reduced. Placement of material within the Beaufort Ebb Tide Delta will also ameliorate future shoreline erosion.

2. Beach disposal of coarse grained material (i.e., 90% or greater sand) on both Bogue and Shackleford Banks will only occur once every three years, which will minimize impacts to intidal macrofauna. Moreover, the two year frequency between placement events will provide sufficient time for recovery of marine biota.

3. The USACE will stagger the beach disposal sites on Shackleford Banks in order to avoid impacting the same section of the ocean strand. Moreover, beach disposal activities on both Bogue and Shackleford Banks would be at an average rate of approximately 200 foot per day or 4-5,000 feet per month; therefore, un-impacted habitat will be available throughout the disposal operation on these ocean beaches.

4. No frontal dunes on Bogue and/or Shackleford Banks will be adversely impacted by the proposed DMMP.

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APPENDIX L

NATIONAL PARK SERVICE
WILDERNESS MINIMUM REQUIREMENTS ANALYSIS (MRA)
CAPE LOOKOUT NATIONAL SEASHORE

ARTHUR CARHART NATIONAL WILDERNESS TRAINING CENTER

MINIMUM REQUIREMENTS DECISION GUIDE

WORKSHEETS

“. . . except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act...”

– the Wilderness Act, 1964

CAPE LOOKOUT NATIONAL SEASHORE

Disposal of Dredged Sediment at Shackleford Banks

September 2013

Please refer to the accompanying MRDG *Instructions* for filling out this guide.

The spaces in the worksheets will expand as necessary as you enter your response.

Step 1: Determine if any administrative action is necessary.

Description: Briefly describe the situation that may prompt action.

Cape Lookout National Seashore (CALO or the Seashore) was authorized March 10, 1966 (P.L. 89-366). Congress amended this Act on October 26, 1974 (P.L. 93-477) and required the Secretary of the Interior to determine the suitability or non-suitability of Seashore lands for wilderness designation. On January 14, 1986, NPS Director William Penn Mott, Jr., signed a Wilderness Recommendation proposing that 2,990 acres of the Shackleford Banks portion of the Seashore be designated as wilderness. Since that time, the National Park Service has managed the lands proposed for wilderness designation in such a way as to preserve their wilderness character.

The United States Army Corps of Engineers (USACE) is currently preparing the Morehead City Harbor Dredged Material Management Plan (DMMP). Once completed, this document will provide a comprehensive guide for dredging and disposal activities associated with the Beaufort Inlet for a 20-year period beginning in 2015. As part of the mitigation component of the plan, the USACE is considering a “beach disposal” alternative. This alternative would include the disposal of dredged sediment onto the beaches of Shackleford Banks, within the area of proposed wilderness. (The boundary of the proposed wilderness is the mean high water line.) The disposal would entail active environmental manipulation and the use of mechanized equipment within proposed wilderness.

The beach disposal alternative would serve to reduce dredging-induced erosion along Shackleford Banks that occurs in part as a result of dredging and maintenance of the navigation channel through Beaufort Inlet. Information contained in several reports suggests that the navigation channel through Beaufort Inlet has exacerbated the erosion of Shackleford Banks, as follows:

- Since 1936, when the navigation channel at Beaufort Inlet was deepened and mostly fixed in position, the ebb tidal delta shoal located offshore of the inlet has deepened, decreased in volume, elongated and been displaced toward the sea.
- The fixed navigation channel along with the maintained depth of the channel have essentially stopped natural sediment bypassing across the inlet (MCH Section 111 Study, USACE 2001).
- Shackleford Banks has assumed a more concaved shoreline configuration compared to its pre-project shape due to build-up on the west and east ends combined with recession along the middle portion of the island. The west end of the island has extended approximately 5,000 feet into Beaufort Inlet. The changes in shoreline behavior on the west and middle portions of the island are strongly associated with the physical changes that have occurred in the shape of the Beaufort Inlet ebb tide delta as a result of the Morehead City Harbor project (MCH Section 111 Study, USACE 2001).
- Overall, from 1974 to 2009, net volumetric losses to the ebb tide delta complex as a whole were estimated to total about 13.4 M cy. Continued erosion of the ebb tide delta complex is likely to impact adjacent beaches through increased wave heights and changes to approach angles; increased shoreline erosion and volumetric losses along the beach and changes in alongshore transport rates and flow paths (Morehead City

Harbor Dredged Material Management Plan Alternative Formulation Briefing (MCH DMMP AFB), May 2010).

- The ebb tidal delta on the Shackleford Banks side (eastern side) of the inlet is also continuing to deepen and deflate based on profiles from 1991 and 2000 (MCH Section 111 Study, USACE 2001). The MCH DMMP AFB (May 2010) estimates that the central eastern portion of the ebb tidal delta has lost 7.4 M cy between 1974 and 2009.
- These profiles also indicate that the offshore portion of Shackleford Banks is getting deeper. From 1991 to 2000 there was a volumetric loss on the order of 900,000 cy/yr above the 35 ft depth contour along Shackleford Banks (MCH Section 111 Study, USACE 2001). Some of this loss is due to a channel deepening event that occurred in 1994. More recent calculations by the USACE compare survey profiles off of Shackleford Banks from 2000 to 2006, 2008 and 2009. All of these surveys have been conducted after the last channel deepening event, so they are more representative of impacts from maintenance dredging. The estimated volume loss along Shackleford Banks is an average of 177,500 cy/year.

In short, the loss of an average of 177,500 cy/year of sediment within the offshore profile during maintenance dredging operations results in an eroding shoreline within certain sections of the park.

If no action is taken, Shackleford Banks will continue to erode, due partially to the human impacts of the navigation channel. This erosion will continue to have a direct, adverse effect on the proposed wilderness at Shackleford Banks.

To determine if administrative action is <u>necessary</u>, answer the questions listed in A - F on the following pages.

A. Describe Options Outside of Wilderness

Is action necessary <u>within</u> wilderness?

Yes: ☑ **No:** ☐

Explain: Yes. Disposal of sediment within proposed wilderness is necessary to offset ongoing loss of the wilderness resource attributable in part to anthropogenic disturbance at Beaufort Inlet. The amount of equipment associated with the beach disposal would be large, due in part to the fact that there is no road on the island. However, the beach disposal is necessary to mitigate ongoing erosion and minimize loss of the wilderness resource.

Nearshore placement outside of proposed wilderness would not serve as adequate mitigation to reduce future losses of beachfront material. Monitoring of nearshore placement sites on the western half of the ebb tidal delta in both 25-ft and 30-ft mean low water depths has indicated very little movement of deposited material (MCH Section 111 Study, USACE 2001). This information suggests that nearshore placement alone may not be sufficient to minimize future sediment losses along Shackleford Banks.

NPS has asked about the possibility of using smaller dredges that could deposit sediment in the intertidal area, immediately adjacent to the park but not within the actual park boundary. In response, USACE has explained that there are compelling reasons why this is not feasible. A smaller dredge that has a shallow draft (15 ft) and can deposit sediment in the intertidal area cannot dredge in water depths greater than 17 ft. The Morehead City Navigation Channel is 45 ft deep; therefore a smaller dredge cannot complete the dredging for this project. In addition, the COLREGS Demarcation Line delineates areas where dredges must be U.S. Coast Guard Ocean-Certified. The line for the MCH project is the land boundary of Shackleford Banks, so the dredge used for this project must be a U.S Coast Guard Ocean-Certified dredge. Based on the limited number of 24" Ocean-Certified pipeline dredges on the U.S. Atlantic Coast, it is likely that this work would be performed by a 30" pipeline dredge. As a result of the sizes, pressures and volumes associated with 30" pipe, it cannot be made from HDPE or a similar light material. Heavy equipment is required to maneuver the pipe.

The potential for placement of material in shallow water using the 30" pipeline dredge was also considered. This is not operationally feasible because it is very difficult and dangerous to move the large pipeline around in shallow water and evenly distribute dredged material. Another technique used internationally is rainbowing, when the channel and placement area are very close and the dredge can shoot the material out in a line about 500 ft. The distance between the channel and placement location would prohibit this method. In addition, the equipment is not available and would need to be specially built for the project, and environmental regulatory agencies may also have concerns.

B. Describe Valid Existing Rights or Special Provisions of Wilderness Legislation

Is action necessary to satisfy valid existing rights or a special provision in wilderness legislation (the Wilderness Act of 1964 or subsequent wilderness laws) that allows consideration of the Section 4(c) prohibited uses? Cite law and section.

Yes: ☐ **No:** ☑ **Not Applicable:** ☐

Explain:

C. Describe Requirements of Other Legislation

Is action necessary to meet the requirements of other laws?

Yes: ☑ **No:** ☐ **Not Applicable:** ☐

Explain: Action is necessary to prevent or minimize loss of habitat for species listed under the Endangered Species Act. Shackleford Banks provides habitat for five threatened or endangered species, including loggerhead sea turtle, green sea turtle, leatherback sea turtle, piping plover, and seabeach amaranth.

D. Describe Other Guidance

Is action necessary to conform to direction contained in agency policy, unit and wilderness management plans, species recovery plans, or agreements with tribal, state and local governments or other federal agencies?

Yes: ☑ **No:** ☐ **Not Applicable:** ☐

Explain: Action is necessary to prevent impairment of park resources, including the wilderness resource. At current rates of erosion, there will be a permanent loss of a portion of the wilderness resource at Shackleford Banks. Ongoing erosion is attributable in significant part to anthropogenic disturbance at Beaufort Inlet. *NPS Management Policies* (2006) Section 6.3.7 provides that management intervention may be undertaken in wilderness “to the extent necessary to correct past mistakes, the impacts of human use, and influences originating of wilderness boundaries.” This same section states that the National Park Service should “seek to sustain the natural distribution, numbers, population composition, and interaction of indigenous species.”

E. Wilderness Character

Is action necessary to preserve one or more of the qualities of wilderness character including: untrammeled, undeveloped, natural, outstanding opportunities for solitude or a primitive and unconfined type of recreation, or unique components that reflect the character of this wilderness area?

Untrammeled: **Yes:** ☐ **No:** ☑ **Not Applicable:** ☐

Explain:

Undeveloped: **Yes:** ☐ **No:** ☑ **Not Applicable:** ☐

Explain:

Natural: **Yes:** ☑ **No:** ☐ **Not Applicable:** ☐

Explain: Action is necessary to prevent loss of natural resources due to ongoing erosion at Shackleford Banks.

Outstanding opportunities for solitude or a primitive and unconfined type of recreation:

Yes: ☐ **No:** ☑ **Not Applicable:** ☐

Explain:

Other unique components that reflect the character of this wilderness:

Yes: ☐ **No:** ☑ **Not Applicable:** ☐

Explain:

F. Describe Effects to the Public Purposes of Wilderness

Is action necessary to support one or more of the public purposes for wilderness (as stated in Section 4(b) of the Wilderness Act) of recreation, scenic, scientific, education, conservation, and historical use?

Recreation: **Yes:** ☑ **No:** ☐ **Not Applicable:** ☐

Explain: Deposition of sediment will minimize loss of additional beach due to erosion and in so doing enhance recreational opportunities.

Scenic: **Yes:** ☑ **No:** ☐ **Not Applicable:** ☐

Explain: Minimizing erosion of the beach will preserve the scenic quality of the proposed wilderness.

Scientific: **Yes:** ☐ **No:** ☑ **Not Applicable:** ☐

Explain:

Education: **Yes:** ☐ **No:** ☑ **Not Applicable:** ☐

Explain:

Conservation: **Yes:** ☑ **No:** ☐ **Not Applicable:** ☐

Explain: Action is necessary to conserve special status species by minimizing loss of habitat.

Historical use: **Yes:** ☐ **No:** ☑ **Not Applicable:** ☐

Explain:

Step 1 Decision: Is any administrative action <u>necessary</u> in

Yes: ☑ **No:** ☐ **More information needed:** ☐

Explain: Action in wilderness is necessary to prevent additional loss of the wilderness resource caused in significant part by anthropogenic disturbance outside the wilderness boundary. Action is likewise necessary to reduce further damage to natural resources within the wilderness, such as vegetation communities, shorebirds, and shellfish.

If action is <u>necessary</u>, proceed to Step 2 to determine the <u>minimum</u> activity.

Step 2: Determine the minimum activity.

Please refer to the accompanying MRDG *Instructions* for an explanation of the effects criteria displayed below.

Description of Alternatives

For each alternative, describe what methods and techniques will be used, when the activity will take place, where the activity will take place, what mitigation measures are necessary, and the general effects to the wilderness resource and character.

Alternative # __No Action___

Description:

Under this alternative, no deposition of sediment would take place. Elevated rates of erosion would continue at Shackleford banks, due in significant part to the maintenance of Beaufort Inlet. The result would be continuing loss and injury to the wilderness resource and related natural resources.

Effects:

Wilderness Character

"Untrammeled"

Proposed wilderness would remain untrammeled in the sense that no active manipulation would take place within the proposed wilderness boundary. However, anthropogenic activities outside wilderness would continue to result in loss of the wilderness resource.

"Undeveloped"

Proposed wilderness would remain undeveloped because no structures would be built.

"Natural"

Proposed wilderness would not be manipulated under this alternative. However, it would continue to experience unnatural rates of erosion due to human activities beyond the proposed wilderness boundary.

"Outstanding opportunities for solitude or a primitive and unconfined type of recreation"

These would continue to exist under this alternative.

Other unique components that reflect the character of this wilderness

N/A

Heritage and Cultural Resources

N/A

Maintaining Traditional Skills

N/A

Special Provisions

N/A

Economic and Time Constraints

N/A

Additional Wilderness-specific Comparison Criteria

N/A

Safety of Visitors, Personnel, and Contractors

This alternative provides the most safety because it does not entail any activity within the proposed wilderness.

Alternative # __A___

Description:

Under this alternative, the disposal of dredged material would occur once every three years, based on the USACE's most recent economic evaluation. Although the total proposed sediment disposal zone would be approximately 3.2 miles in length, each triennial sand disposal would cover approximately one linear mile at a width of approximately 75 – 100 feet. The volume of material placed on the beach would partially mitigate for the best estimate of the volume lost in the island profiles from maintenance dredging, but would not exceed the estimate of the volume lost. All these estimates are subject to further evaluation in the NEPA process. They are also dependent on the availability of Federal appropriations.

Typical equipment necessary to perform the beach disposal operations on Shackleford Banks as indicated by the USACE includes lengths of shore pipe 30 inches in diameter, bulldozers for the spreading and leveling of the beach fill material, and front-end loaders and excavators for handling, re-locating, assembling and disassembling the shore-pipe. Other materials needed include portable generators, welding machines, mobile light generating plants, portable fuel tanks, and various shore-pipe connectors. Pick-up trucks, ATV type vehicles, portable toilet facilities, a barge landing ramp and a mobile office trailer may also be needed. The window for having equipment on the beach would be limited to November 16 – March 31 of any given year to accommodate sea turtle nesting activities.

A typical Beaufort Inlet maintenance dredging project with beach disposal project would be performed with a 30-inch hydraulic cutterhead pipeline dredge. The cutterhead dredge would operate in the Federal navigation channel with its discharge pipeline extending to the sand disposal area.

The time of sand disposal is restricted by sea turtle nesting the potential for nesting birds; and can only take place in the winter months between November 16 and March 31 of any given year. Material and equipment mobilization (on the island) is typically allowed to extend one month prior to, and following, the sand disposal window. However, equipment on the beach would be limited to the November 16-March 31 sea turtle nesting window.

The proposed sand disposal zone is approximately 3.2 miles in length. Based on the Wilmington District's most recent economic evaluation, sand disposals would occur once every three years. Each sand disposal would cover approximately one linear mile (within the 3.2 mile zone) at a width of approximately 75-100 ft. All estimates are subject to further evaluation and subject to the availability of Federal appropriation.

Materials, equipment and personnel needed for sand disposal operations would be mobilized to and from Shackelford Banks via barge. Below are the typical materials and equipment necessary to perform beach disposal operations:

- 1-2 Mobile office trailer - needed to provide contractor personnel with shelter and office space to manage the beach disposal work

- 1-2 portable toilet facilities

- Sufficient lengths of 30-inch shore-pipe - needed to extend the full length of beach fill

- Various shore-pipe connectors, including: y-valves, effluent diffusers, flange plates, etc

- 2-3 large portable generators - needed for assembly and disassembly of the shore-pipe

- 1-2 Portable Welding machines - needed for assembly, disassembly and repair of the shore-pipe

- 1-2 PC-120 sized excavators - needed for handling, re-locating, assembling and disassembling of the shore-pipe

- 2-3 D-8 sized bulldozers - needed to construct effluent control toe-berms, level dredged material across the beach fill template and to aid in the landing of the pipeline from the ocean to Shackelford Banks

- 1-2 Standard pick-up trucks - needed to mobilize personnel from the vessel landing area to various areas within the beachfill template

- 1-2 Front-end loaders - needed for handling, re-locating, assembling and disassembling of the shore-pipe

- 3-4 Mobile Light Generating Plants - needed to provided sufficient lighting during nighttime operations

- 1-2 ATV type vehicles - needed for pipeline inspection, topographic surveying, etc

- 1 Barge landing ramp - needed to minimize damage to shoreline during mobilization/demobilization of material, equipment and personnel

- 2-3 Portable fuel tanks - needed to provide fuel for equipment.

Although the window of operation is between the months of November and March 31, the activities should take place in limited areas for the least amount of time. This would be consistent with the NPS Minimum Requirements policy.

Effects:

Wilderness Character

“Untrammeled”

Proposed wilderness in a 3.2-mile section of beach face would be trammeled due to the active, mechanized deposition of sediment.

“Undeveloped”

Proposed wilderness would remain undeveloped because no permanent structures would be built.

“Natural”

Proposed wilderness would lose some of its natural character under this alternative due to active manipulation of the beach front along a 3.2-mile section of beach. However, this action would prevent the loss of additional habitat at Shackleford Banks and restore habitat for certain biota.

“Outstanding opportunities for solitude or a primitive and unconfined type of recreation”

Opportunities for solitude would be substantially impacted every three years during times of active sediment deposition. The wilderness experience would be adversely affected by the presence of heavy equipment and temporary structures.

Other unique components that reflect the character of this wilderness

N/A

Heritage and Cultural Resources

N/A

Maintaining Traditional Skills

N/A

Special Provisions

N/A

Economic and Time Constraints

N/A

Additional Wilderness-specific Comparison Criteria

N/A

Safety of Visitors, Personnel, and Contractors

This alternative provides less safety for visitors, personnel, and contractors than the no action alternative because of the possibility of injury from machinery or land vehicles.

(Note: Other action alternatives such as nearshore deposition and deposition in the intertidal region have been investigated and found to be not feasible. Therefore, this document only analyzes a “no action” alternative and one action alternative, Alternative A.)

Comparison of Alternatives

It may be useful to compare each alternative's positive and negative effects to each of the criteria in tabular form, keeping in mind the law's mandate to "preserve wilderness character."

	Alternative A	Alternative B	Alternative C	No Action
Untrammeled	-			+
Undeveloped				
Natural	+			+
Solitude or Primitive Recreation	-			+
Unique components				
WILDERNESS CHARACTER				

	Alternative A	Alternative B	Alternative C	No Action
Heritage & Cultural Resources				
Maintaining Traditional Skills				
Special Provisions				
Economics & Time				
Additional Wilderness Criteria				
OTHER CRITERIA SUMMARY				

	Alternative A	Alternative B	Alternative C	No Action
SAFETY		-		+

Safety Criterion

If safety issues override impacts to wilderness character or other criteria, provide documentation that the use of motorized equipment or other prohibited uses is necessary because to do otherwise would cause increased risks to workers or visitors that cannot be satisfactorily mitigated through training, use of personal protective equipment (PPE), or other requirements to alleviate the safety risk. (This documentation can take the form of agency accident-rate data tracking occurrences and severity; a project-specific job hazard analysis; research literature; or other specific agency guidelines.)

Documentation:

The nature of the proposed action is such that it can only be accomplished using mechanized equipment.

Step 2 Decision: What is the Minimum Activity?

Please refer to the accompanying MRDG *Instructions* before describing the selected alternative and describing the rationale for selection.

Selected alternative: Alternative A is the selected alternative.

Rationale for selecting this alternative (including documentation of safety criterion, if appropriate):

Alternative A will have substantial temporary, recurring impacts to wilderness character, but will help preserve natural and wilderness resources at Shackleford Banks. The no action alternative will not achieve the objective of preventing and offsetting loss to the wilderness resource.

Monitoring and reporting requirements:

To the extent feasible, baseline information will be collected prior to sediment deposition to document "before" conditions. Sediment sampling will be conducted along Shackleford Banks to document the quantitative values of the native beach (grain size distribution, sediment color, visual shell % content) prior to the disposal of dredged material. Baseline information on shorebirds, sea turtles, and some plants has been collected through the monitoring program associated with the park's Interim Protected Species Plan. The park will continue its current monitoring program after deposition actions.

Check any Wilderness Act Section 4(c) uses approved in this alternative:

- ☑ mechanical transport
- ☑ motorized equipment
- ☑ motor vehicles
- ☑ motorboats
- ☐ landing of aircraft
- ☐ temporary road
- ☑ temporary structure or installation

Record and report any authorizations of Wilderness Act Section 4(c) uses according to agency procedures.

Approvals	Signature	Name	Position	Date
Prepared by:				
Recommended:				
Recommended:				
Approved:				

APPENDIX M

AGENCY TECHNICAL REVIEW (ATR)
OF
DRAFT DMMP AND EIS

Completion of Agency Technical Review

MOREHEAD CITY HARBOR DMMP

Wilmington, North Carolina

May, 2010

Wilmington District has completed the dredged material management plan for the Morehead City Harbor Navigation Project. Notice is hereby given that an Agency Technical Review (ATR) has been conducted that is appropriate to the level of risk and complexity inherent in the project. The dredged material management plan (DMMP) was reviewed for compliance with established principles and procedures, using clearly justified and valid assumptions. Further, methods and procedures were reviewed to determine the appropriateness, correctness, and reasonableness of results, including determination of whether the plan meets the customer's needs consistent with law and existing United States Army Corps of Engineers policy.

An independent technical review team composed of members from, Honolulu, Mobile, and Walla Walla Districts performed the review. The Deep Draft Navigation Planning Center of Expertise (DDNPCX) managed the conduct of this review using the DrChecks software. The ATR was initiated on 29 March 2010, and completed on 21 May 2010. A complete copy of the final comment report from DrChecks is enclosed.

The ATR team placed 101 comments in DrChecks. After evaluations were completed by the Project Delivery Team (PDT), there were 15 "NonConcur" during the Backcheck by the ATR team. Coordination between the ATR team and PDT on the areas of concern resulted in satisfactory resolution of these comments. All of the review comments and evaluations are found in the attached ProjNet Report.

The Cost DX at Walla Walla has certified the costs in the report. The overall report has been fully reviewed, and all associated documentation required by the National Environmental Policy Act has been complied with. We certify that the DMMP for the Morehead City Harbor Navigation Project ATR was performed as required by Engineer Circular (EC) 1165-2-209, Civil Works Review Policy, dated 31 January 2010.

Bernard E. Moseby
Deputy Director
Deep Draft Navigation
Planning Center of Expertise

Enclosure

DEPARTMENT OF THE ARMY
US ARMY CORPS OF ENGINEERS
SOUTH ATLANTIC DIVISION
60 FORSYTH STREET SW, ROOM 10M15
ATLANTA, GA 30303-8801

REPLY TO
ATTENTION OF

CESAM-PD-D (1105-2-40a) 8 November 2012

MEMORANDUM FOR MS. JENNIFER OWENS (CESAW-TS-PE) U.S. ARMY CORPS OF ENGINEERS, WILMINGTON DISTRICT, 69 DARLINGTON AVENUE, WILMINGTON, NORTH CAROLINA, 28402-1890

SUBJECT: Certification and Completion of Agency Technical Review, Morehead City Harbor Draft Integrated Dredging Material Management Plan and EIS

1. References:

a. EC 1165-2-209, Civil Works Review Policy, 31 January 2010

b. EC 1105-2-412, Assuring Quality of Planning Models, 31 March 2011

c. Memorandum, CECW-CP, 30 March 2007, Subject: Peer Review Process

d. Supplemental information for the "Peer Review Process" Memo, dated March 2007

2. In accordance with EC 1165-2-209, "Civil Works Review Policy," dated 31 January 2010, Final Agency Technical Review (ATR) of the Draft Dredging Material Management Plan (DMMP) and Environmental Impact Statement (EIS) dated August 2012, has been coordinated with and executed through the Deep Draft Navigation Planning Center of Expertise (DDNPCX).

3. ATR comments were posted in DrChecks, evaluated by the Project Delivery Team (PDT), and back checked and closed out by the ATR team for incorporation into the DMMP. The cost engineering products supporting the DMMP (estimates, schedules, risk analyses and cost roll-ups) were formally and successfully ATRd by the Cost Engineering MCX and no significant outstanding issues or concerns were found. The DDNPCX point of contact is Mr. Johnny L Grandison, CESAM-PD-D, (251) 694-3804.

for Johnny L Grandison

Encls

BERNARD E. MOSEBY
Technical Director, DDNPCX

CF:
CESAD-PDS/PAYNES
CESAD-PDS/STRATTON
CESAD-PDS/SMALL

APPENDIX N

REAL ESTATE

REAL ESTATE APPENDIX

Morehead City Harbor
Morehead City, NC
Draft Integrated Dredged Material Management Plan and Environmental Impact Statement

Table of Contents

SECTION 1. THE REAL ESTATE REPORT

1.1 Statement of Purpose

This report is tentative in nature, focuses on the Tentatively Selected Plan, and is to be used for planning purposes only. There may be modifications to the plans that occur during Pre-construction, Engineering and Design (PED) phase, thus changing the final acquisition area(s) and/or administrative and land cost. The Real Estate Appendix is intended to support the Dredged Material Management Plan (DMMP) and Environmental Impact Statement for Morehead City Harbor, Morehead City, NC. The author of this report is familiar with the Project area. The state of North Carolina is the non-Federal sponsor for the project. Date of this report is April 2013.

1.2 Study Authority

The U. S. Army Corps of Engineers (USACE) Appendix E-15 of ER 1105-2-100 provides that a DMMP be developed for federal navigation projects if a Preliminary Assessment does not demonstrate sufficient capacity to accommodate maintenance dredging for the next twenty years. The DMMP is a planning document that ensures maintenance-dredging activities are performed in an environmentally acceptable manner, use sound engineering techniques, and are economically justified. A DMMP addresses dredging needs, disposal capabilities, capacities of disposal/placement areas, environmental compliance requirements, potential for beneficial use of dredged material and indicators of continued economic justification. Beneficial use is defined as utilizing dredged sediments as resource materials in productive ways. Dredged Material Management Plans ensure that sufficient placement capacity is available for at least the next 20 years and should be updated periodically to identify any potentially changed conditions.

In addition to ER 1105-2-100, three Policy Guidance memoranda provide additional guidance regarding the preparation of DMMPs. They are: 1) Policy Guidance Letter (PGL) No. 40, dated March 1993, Development and Financing of Dredged Material Management Studies; 2) PGL No. 42, dated March 1993, Additional Guidance on Financing of Dredged Material Management Studies and 3) PGL No. 47, dated April 1998, Cost Sharing for Dredged Material Disposal Facilities and Dredged Material Disposal Facility Partnerships.

1.3 Project Location

Morehead City Harbor is a federal navigation project located in the Town of Morehead City, North Carolina, approximately 3 miles from the Atlantic Ocean through Beaufort Inlet (Figure 1.3-1). The authorized Morehead City Harbor project is divided into two parts: The deep draft portion and the shallow draft portion. As shown on Figure 1.3-2, the deep draft portion consists of three main ranges or sections: the Inner Harbor, which includes the Northwest, West, and East Legs and North Range C; the Outer Harbor, which includes South Range C, Range B, the Cutoff and Range A out to Station 110+00; and the Outer Entrance Channel, which is made up of the seaward end of Range A (from station 110+00 out); the shallow draft portion includes 3 additional ranges: the Entrance Channel, Waterfront Channel and Bogue Sound Channel. In addition to the Morehead City Harbor navigation channels, the DMMP study area also includes the adjacent mainland area, the beaches of Bogue Banks and Shackleford Banks, the nearshore Atlantic Ocean off of Bogue Banks and Shackleford Banks (ebb tide delta), the Environmental Protection Agency (EPA) designated Ocean Dredged Material Disposal Site (ODMDS), and the existing disposal sites of Brandt Island, Marsh

Island and Radio Island.

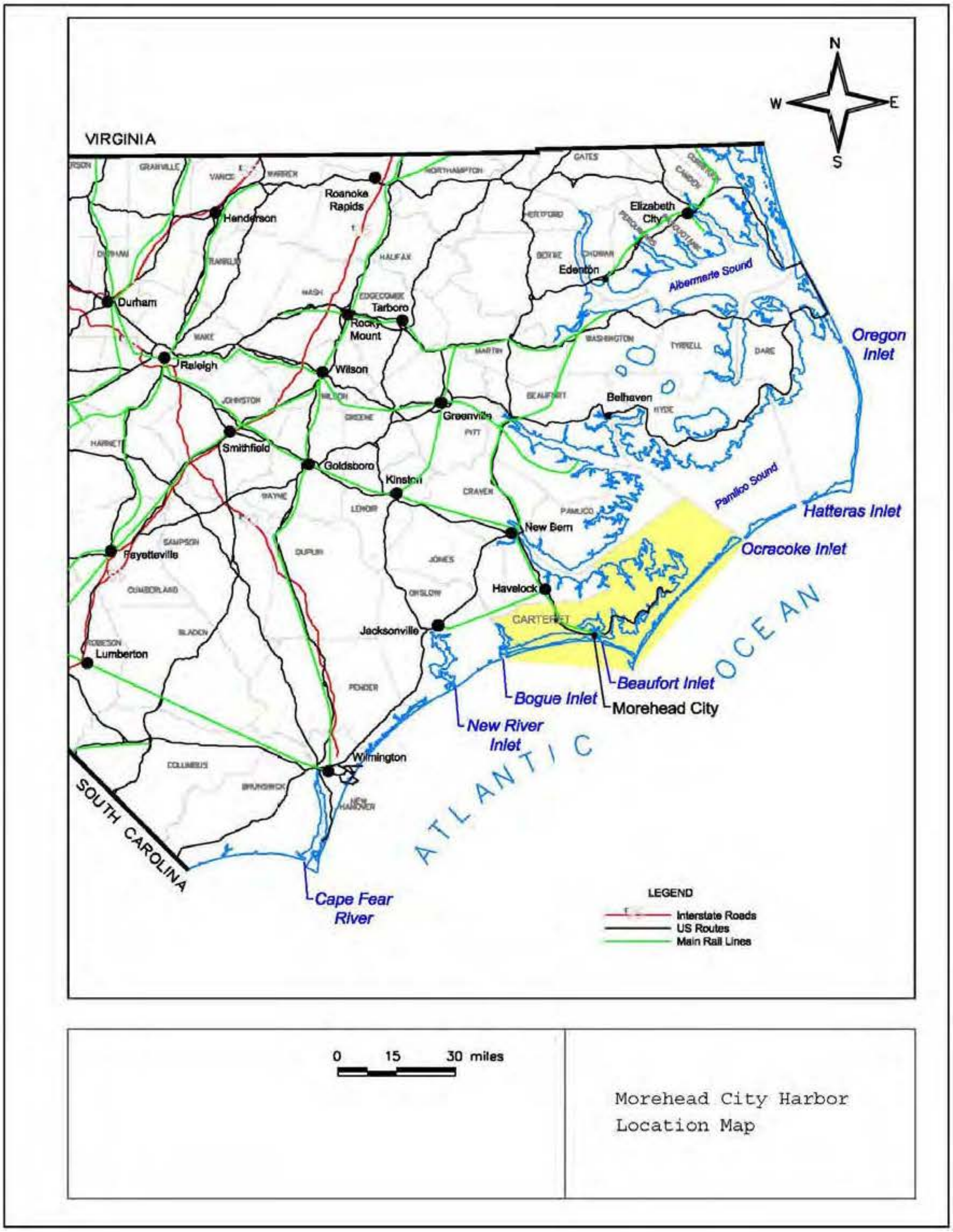

Figure 1.3-1. Project Vicinity/Location Map

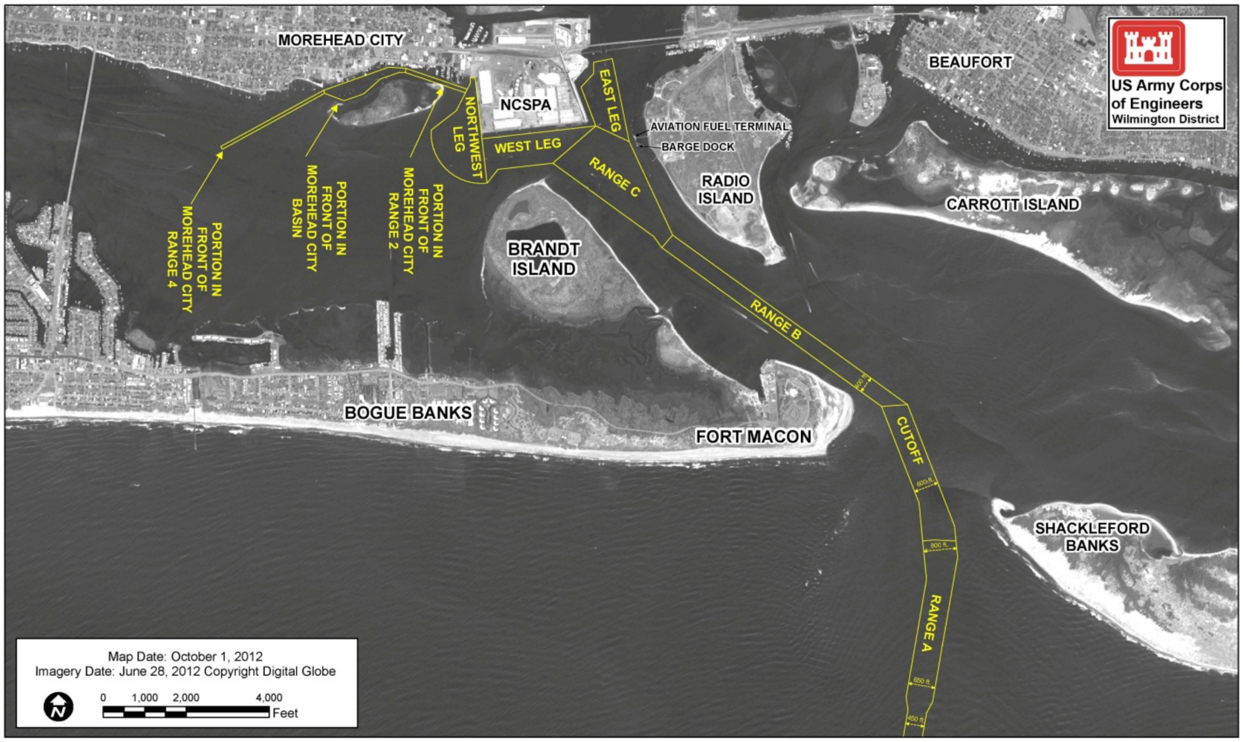

Figure 1.3-2 – Morehead City Harbor Federally Authorized Navigation Project

1.4 Project Description

The DMMP addresses dredging needs, disposal capabilities, and capacities of disposal areas with the purpose of ensuring sufficient disposal capacity for at least the next 20 years, beginning in 2015 and extending through 2034. Approximately 1 million cubic yards of dredged material are removed from the Morehead City Harbor annually. Current maintenance disposal practices, without modification, result in the need for “new” or expanded disposal sites or modified disposal options, including beneficial uses, by 2028. The proposed DMMP (base plan) provides virtually unlimited disposal capacity for the Morehead City Harbor navigation project by recommending the following: continued use of Brandt Island without expansion, placement of coarse-grained material on the beaches of Fort Macon State Park, Atlantic Beach, and Shackleford Banks, expansion of the Nearshore West placement area, a new Nearshore East placement area and continued use of the EPA designated ODMDS. The proposed DMMP (base plan) is show at Figures 1.4-1 through 1.4-3.

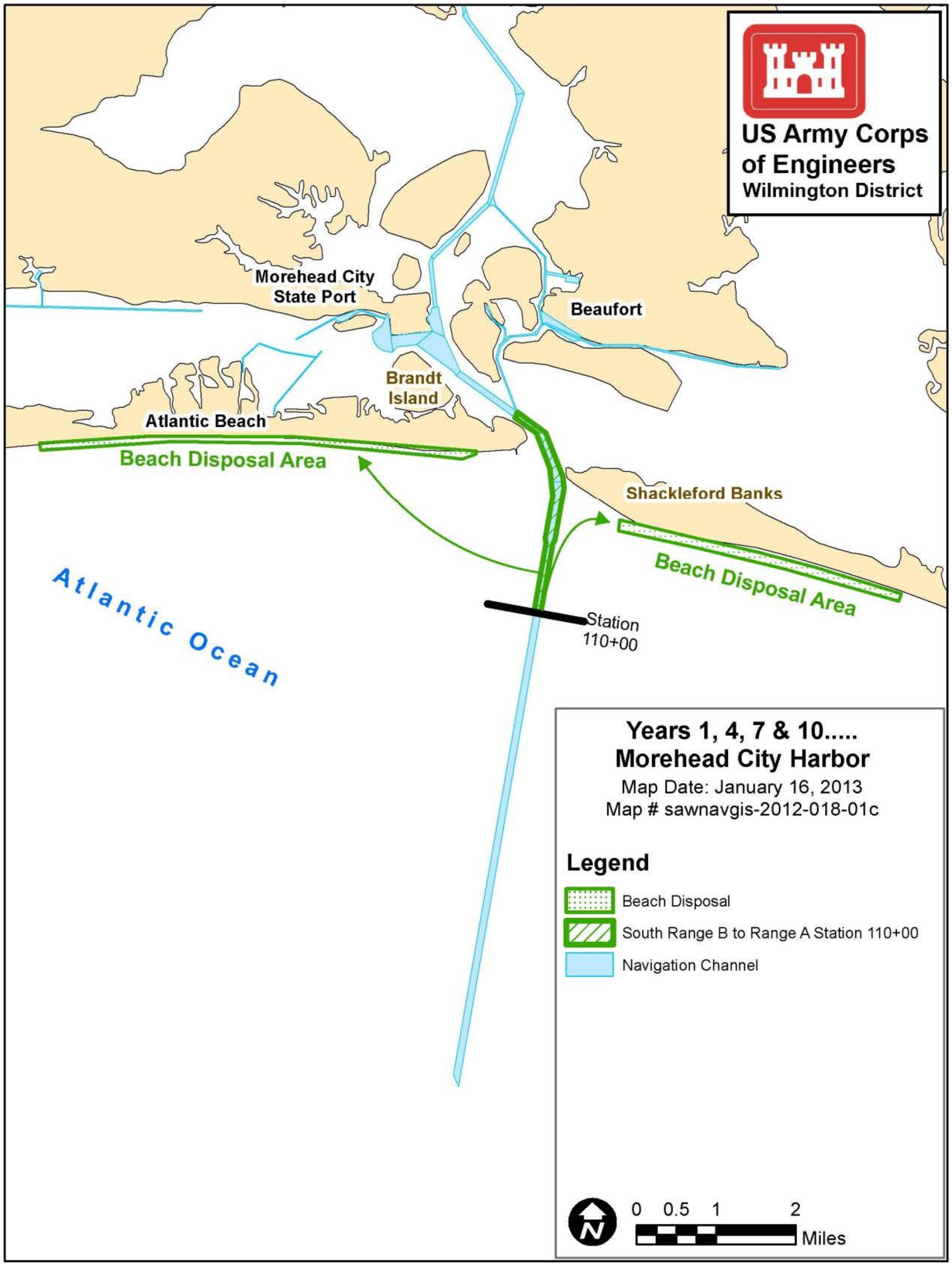

Figure 1.4-1. Proposed Base Plan – Years 1,4,7,10…….

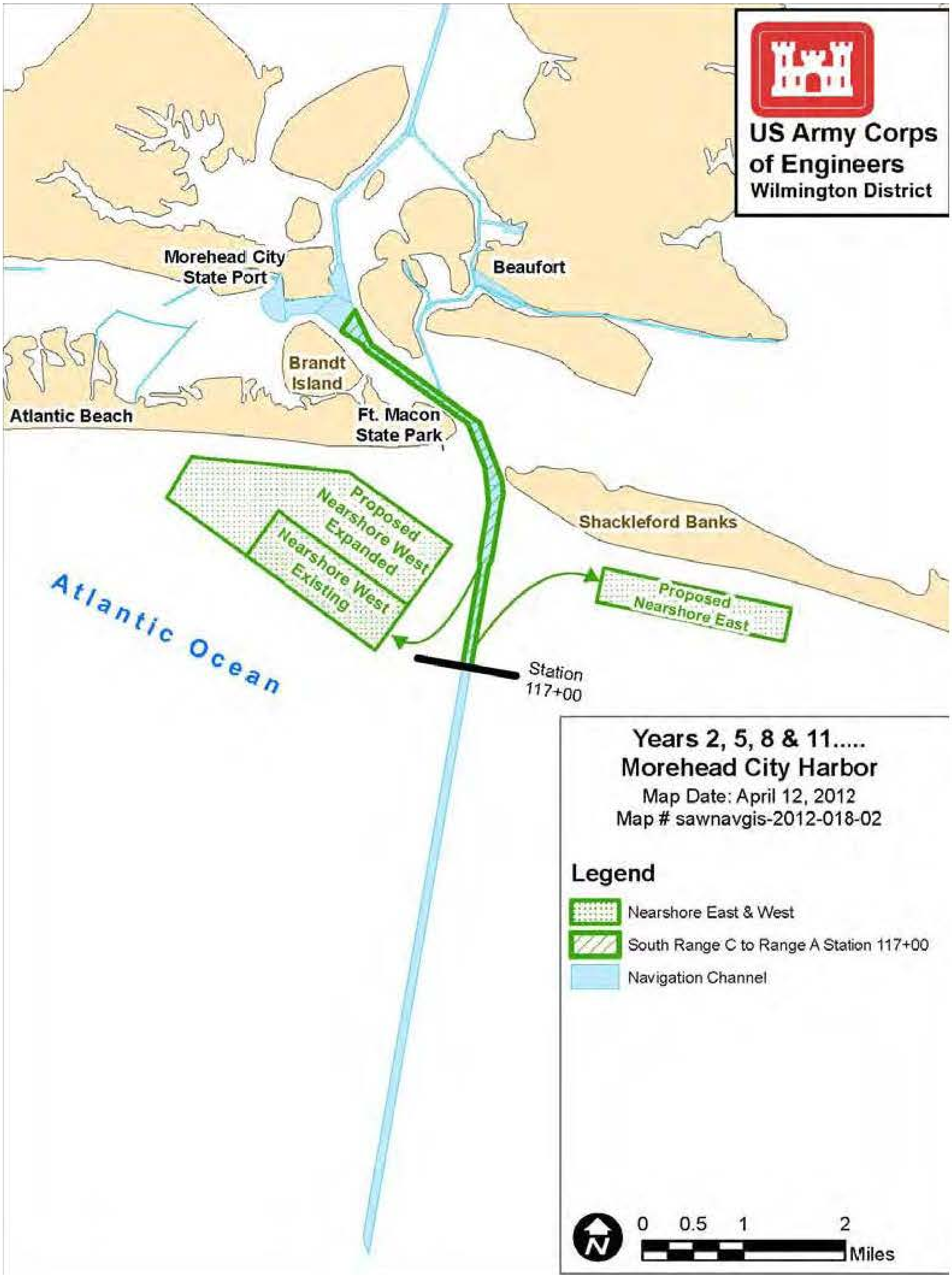

Figure 1.4-2 - Proposed Base Plan – Years 2, 5, 8, 11…..

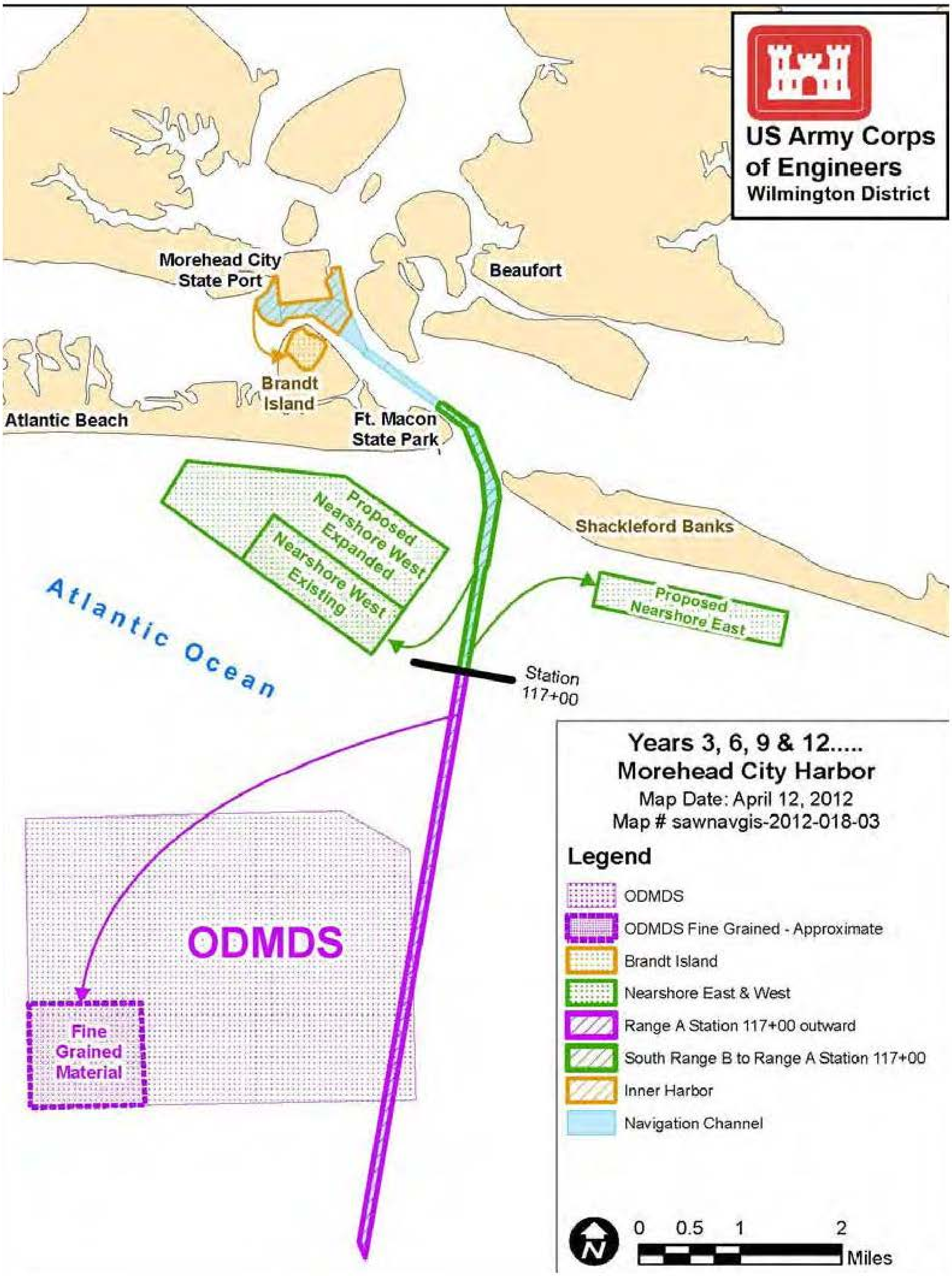

Figure 1.4-3 - Proposed Base Plan – Years 3,6,9,12………

1.5 Real Estate Requirements

Brandt Island. A large portion of the Island is owned by the State of North Carolina and since the 1950's has been dedicated for use as a disposal area. It is proposed that dredged material from the Inner Harbor be placed in Brandt Island. For past disposal events the State of North Carolina has either granted a temporary disposal easement or given a letter permit for use of the Brandt Island site. The same would be required for any subsequent use of the site.

Beaches at Fort Macon State Park. Dredged materials from the Outer Harbor will likely be placed on the beach of Fort Macon State Park which is owned by the State of North Carolina. No formal agreement exists between the USACE and the State pertaining to placement of material at Fort Macon. However, prior to each placement event, the USACE coordinates closely with the State Park regarding the details of the placement activity. Either an easement or a letter permit from the State will be required to make Fort Macon State Park available for project purposes.

Beaches of Atlantic Beach. Dredged materials from the Outer Harbor will also be placed on Atlantic Beach which is privately owned landward of mean high water (MHW). In 2005 sand was pumped from Brandt Island onto the shoreline to create more disposal capacity within the Brandt Island site. At that time, 209 parcels were impacted by the placement of fill. There were 150 perpetual easements in place and 59 temporary easements were acquired, which have since expired. The easement language used in the acquired easements was very similar to the standard “Perpetual Beach Storm Damage Reduction Easement” in Section 1.20.

An assumption is that the last sand placement created new lands which vested in state ownership. The expectation with future placement events is that fill will be placed on or below the land created at the last fill and that no further real estate interests will be required; however, this will be confirmed when surveys are completed prior to each beach placement event. Should there be areas where erosion has occurred landward of the old mean high water line, easements will be required from impacted landowners. It is suggested that the standard Perpetual Beach Storm Damage Reduction Easement be used if additional easements are required.

The worst case scenario under the recommended base plan is acquisition of approximately 59 easements. Should future beach placement occur on Bogue Banks west of the area included in the base plan, additional easements would be required, incurring additional real estate costs that cannot be accurately estimated at this time. Placement of sand along the shoreline is considered beneficial use of dredged material and is not considered a nourishment project. The sponsor will not receive credit for cost incurred in the acquisition of easements.

Beaches of Shackleford Banks. The beaches of Shackleford Banks may also receive dredged material from the Outer Harbor. Shackleford Banks is part of the Cape Lookout National Seashore, which is managed by the National Park Service. A Special Use Permit (SUP) will be required from the NPS prior to each placement event and all conditions of the SUP will be met. No other real estate is required.

The dredge contractor will not be allowed to impact the existing frontal dune along the ocean strand from the spit to the placement area on Shackleford Banks. All beach equipment (dozers, pipeline sections, etc.) will be walked during low tide along the beach strand to the placement site. This also means that no dredge pipeline from the dredge to the placement area will be aligned along the ocean beach strand from the spit to the placement area on Shackleford Banks. The end of the dredge pipeline will be submerged offshore from the dredge working in the harbor channels to the placement site on Shackleford Banks. Once the end of the dredge pipeline emerges onshore within the sediment berm placement site, the contractor will set up the dump shack, fencing, light stands and stockpile additional shore pipe within the constructed upland berm area (seaward of the existing frontal dune).

Nearshore West. The Nearshore West Placement Area is within State territorial waters and is located off Bogue Banks. Dredged material from the Outer Harbor will be disposed of in the Nearshore West site. The existing site is 559 acres but plans to expand the existing site by an additional 1,209 acres are being coordinated with all appropriate resource agencies. The site is available through navigation servitude, but a permit for use of the placement area will be obtained from the State of North Carolina.

Nearshore East. The Nearshore East site (Figure 3-23) is a newly proposed site that will consist of approximately 1,094 acres and will be located within State waters off Shackleford Banks. Dredged material from the Inner Harbor will be disposed of in the Nearshore East. The site is available through navigation servitude. Plans to construct the new site are being coordinated with all appropriate resource agencies and a permit will be obtained from the State of North Carolina for use of the site.

ODMDS. The ODMDS (Figure 3-40) is an 8 square mile area located on the Outer Continental Shelf (OCS) and is also available through navigation servitude. The site was designated by EPA as an ocean dredged material disposal site. The transportation and disposal of dredged material in ocean waters, including the territorial sea, is regulated under the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA) (Public Law 92-532, 86 Stat. 1052, 33 U.S.C. §§1041 et seq.) as amended by Title V of the Water Resources Development Act of 1992 (WRDA 92; Public Law 102-580). Section 102(a) of MPRSA authorizes the U.S. Environmental Protection Agency (EPA) to establish and apply regulations and criteria for ocean dumping activities. Consequently, the EPA issued in October, 1973, and revised in January, 1977, Ocean Dumping Regulations and Criteria (40 CFR 220-238). These regulations establish control of ocean dredged material disposal primarily by two activities, designation of sites for ocean dumping and the issuance of permits for dumping.

The transportation of dredged material for the purpose of disposal into ocean waters (i.e. the actual use of the designated site) is permitted by USACE (or authorized in the case of federal projects) under MPRSA Section 103(e) applying environmental criteria established in EPA's Ocean Dumping Regulations and Criteria. The MPRSA Section 104(a)(3) provides that ocean disposal of dredged material can occur only at a designated site and Section 103(b) requires the USACE to utilize dredged material disposal sites designated by EPA to the maximum extent feasible. Prior to issuing a dredged material permit or authorizing a federal project involving the ocean disposal of dredged material, the USACE must notify EPA, who may disapprove the proposed disposal. Dredged material from the Inner Harbor, Outer Harbor and Outer Entrance Channel may be disposed of in the ODMDS.

No staging areas have been identified at time of this report. When specific requirements are determined, the sponsor will be responsible for providing staging areas for the project which shall be provided prior to advertisement for construction. However, should a contractor determine that another site may be more preferable and/or convenient, he will have the option to obtain an alternate site for staging.

1.6 Utility/Facility Relocation

There are no utility/facility relocations with this project

1.7 Existing Projects

The Morehead City Harbor Project and the Morehead City Section 933 are existing Federal projects.

1.8 Environmental Impacts

The proposed DMMP is not expected to adversely affect the environment. The proposed Morehead City Harbor DMMP is not expected to result in any significant adverse environmental effects. Significant resources (including terrestrial and marine biota, cultural resources, threatened and endangered species, air and water quality, socio-economics, esthetics, and recreation) will not be adversely impacted by implementation of the proposed DMMP.

1.9 Project Sponsor Responsibilities and Capabilities

The State of North Carolina will be the non-Federal Project Sponsor (NFS). The NFS has the responsibility to acquire all real estate interests required for the Project. The NFS shall accomplish all alterations and relocations of facilities, structures and improvements determined by the government to be necessary for construction of the Project. A form for the Assessment of the Non-Federal Sponsor's Capability to Acquire Real Estate is at Exhibit "A" to the Real Estate Appendix.

Prior to advertisement of any construction contract, the NFS shall furnish to the government an Authorization for Entry for Construction (Exhibit "B" to the Real Estate Appendix) to all lands, easements and rights-of-way, as necessary. The NFS will also furnish to the government evidence supporting their legal authority to grant rights-of-way to such lands

No land acquisition is required for this project. Consequently the usual requirements of the NFS pertaining to real estate acquisition are not applicable. The non-Federal sponsor is entitled to receive credit against its share of project costs for any real estate related administrative costs incurred for the project.

1.10 Government Owned Property

The State of North Carolina owns a portion of Brandt Island and also Fort Macon State Park within the project limits. Shackelford Banks is part of the Cape Fear Lookout National Seashore which is managed by the National Park Service.

1.11 Historical Significance

It is anticipated that resources in the area will be limited to shipwrecks that may be impacted by direct deposit of dredged material or by induced changes in current patterns. Direct project impacts will be limited to submerged cultural resources and are likely to be minimal. The actual extent of impact will depend on the amount of material placed on or near cultural resources and the chemical composition of the material. If beach quality or near beach quality material is deposited, chemical impacts will be minimal or non-existent. If dredged material release locations are specified in the contract and are monitored so that no mounding occurs on or near cultural resources, then effects from altered current are also likely to be minimal or nonexistent.

1.12 Mineral Rights

There are no known mineral activities within the scope of the proposed project.

1.13 Hazardous, Toxic, and Radioactive Waste (HTRW)

No HTRW sites are located in the project area and therefore neither the proposed DMMP nor the No Action plan will impact any HTRW sites. Also, neither plan would result in the placement of contaminated sediments in any disposal areas within the project area.

1.14 Navigation Servitude

The navigation servitude is the dominant right of the Government under the Commerce Clause of the U.S. Constitution (U.S. CONST. Art. I, §8, cl.3) to use, control and regulate the navigable waters of the United States and the submerged lands hereunder for various commerce-related purposes including navigation and flood control. In tidal areas, the servitude extends to all lands below the mean high water mark.

1.15 Zoning Ordinances

Zoning ordinances are not of issue with this project. Application or enactment of zoning ordinances is not to be used in lieu of acquisition.

1.16 Induced Flooding

There will be no flooding induced by the construction or the operation and maintenance of the project.

1.17 Public Law 91-646, Relocation Assistance Benefits

There are no relocations of individuals, businesses or farms for this project.

1.18 Attitude of Property Owners

The project is fully supported. There are no known objections to the project from landowners within the project area.

1.19 Acquisition Schedule

No real estate acquisition is currently required for the project. Should it later be determined that easements are required along Atlantic Beach for a least cost disposal, the locals will be responsible for acquiring those easements and a milestone schedule will be prepared at that time.

1.20 Estates for Proposed Project

Should easements be required on Atlantic Beach, the Perpetual Beach Storm Damage Reduction Easement is suggested.

PERPETUAL BEACH STORM DAMAGE REDUCTION EASEMENT

A perpetual and assignable easement and right-of-way in, on, over and across (the land described in Schedule A) (Tract No. __) for use by the (Project Sponsor), its representatives, agents, contractors, and assigns, to construct; preserve; patrol; operate; maintain; repair; rehabilitate; and replace; a public beach [a dune system] and other erosion control and storm damage reduction measures together with appurtenances thereto, including the right to deposit sand; to accomplish any alterations of contours on said land; to construct berms [and dunes]; to nourish and renourish periodically; to move, store and remove equipment and supplies; to erect and remove temporary structures; and to perform any other work necessary and incident to the construction, periodic renourishment and maintenance of the (Project Name), together with the right of public use and access; [to plant vegetation on said dunes and berms; to erect, maintain and remove silt screens and sand fences; to facilitate preservation of dunes and vegetation through the limitation of access to dune areas;] to trim, cut, fell, and remove from said land all trees, underbrush, debris, obstructions, and any other vegetation, structures and obstacles within the limits of the easement (except_____); [reserving, however, to the grantor(s), (his) (her) (its) (their) (heirs), successors and assigns, the right to construct dune overwalk structures in accordance with any applicable Federal, State or local laws or regulations, provided that such structures shall not violate the integrity of the dune in shape, dimension or function, and that prior approval of the plans and specifications for such structures is obtained from the (designated representative of the Project Sponsor) and provided further that such structures are subordinate to the construction, operation, maintenance, repair, rehabilitation and replacement of the project; and further] reserving to the grantor(s), (his) (her) (its) (their) (heirs), successors and assigns all such rights and privileges as may be used and enjoyed without interfering with or abridging the rights and easements hereby acquired; subject however to existing easements for public roads and highways, public utilities, railroads and pipelines.

1.21 Real Estate Estimate

The estimated real estate costs include federal and non-federal administrative costs. Administrative costs are those costs incurred for verifying ownership of lands, certification of those lands required for project purposes, legal opinions, analysis or other requirements that may be necessary during Planning, Engineering and Design (PED). A 10% contingency is applied to the estimated total for these items.

Table 1.21-1.

Real Estate Estimate

a. Lands		0
b. Improvements		0
(Residential)		0
(Commercial)		0
c. Mineral Rights		0
d. Damages		0
e. P.L. 91-646 Relocation costs		0
f. Acquisition Cost - Admin (permits)		5,800
Federal	2,900	
Non-federal	2,900	
	5,800	
Sub-Total		5,800
Contingencies (10%)		580
TOTAL		**6,380**
ROUNDED		**6,500**

1.22 Chart of Accounts

The cost estimate for all Federal and non-Federal real estate activities necessary for implementation of the project after completion of the feasibility study for land acquisition, construction, LERRD, and other items are coded as delineated in the Cost Work Breakdown Structure (CWBS). This real estate cost estimate is then incorporated into the Total Current Working Estimate utilizing the Microcomputer Aided Cost Engineering System (MCACES).

Table 1.22-1.

Chart of Accounts

		Federal	Non-Federal	Total
01B	LANDS AND DAMAGES			
01B40	Acquisition/Review of NFS			
01B20	Acquisition by NFS			
01BX	Contingencies (10%)			
	Subtotal			
01G	Permit/License/ROE			
01G10	By Government	2,900		2,900
01G20	By NFS		2,900	2,900
01G30	By Government on Behalf of NFS			
01GX	Contingencies (10%)	290	290	580
	Subtotal	3,190	3,190	6,380
01H	AUDIT			
01H10	Real Estate Audit			
01HX	Contingencies (10%)			
	Subtotal			
01R	REAL ESTATE LAND PAYMENTS			
01R1B	Land Payments by NFS			
01R2B	PL91-646 Relocation Payment by NFS			
01R2D	Review of NFS			
01RX	Contingencies (10%)			
	Subtotal			
	TOTALS		3,190	6,380
	ROUNDED TO			**$6,500**

Real Estate Certification

The Real Estate Appendix for the Morehead City Harbor DMMP has been prepared in accordance with policy and guidance set forth in ER 405-1-12, Chapter 12, Real Estate Planning and Acquisition Responsibilities for Civil Works Projects.

Prepared by:

Belinda Estabrook

Realty Specialist

Reviewed and approved by:

Ralph J. Werthmann

Ralph J. Werthmann
Chief, Real Estate Division

8 April 2013

Exhibits

Exhibit A – Assessment of Non-Federal Sponsor's Real Estate Acquisition Capability
Exhibit B - Authorization For Entry For Construction

Assessment of Non-Federal Sponsor's Real Estate Acquisition Capability Morehead City Harbor DMMP

I. Legal Authority:

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes? **YES**

b. Does the sponsor have the power to eminent domain for this project? **YES**

c. Does the sponsor have "quick-take" authority for this project? **YES**

d. Are any of the land/interests in the land required for this project located outside the sponsor's political boundary? **NO**

e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn? **NO**

II. Human Resource Requirements:

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including P. L. 91-646, as amended? **NO**

b. If the answer to II.a. is "yes", has a reasonable plan been developed to provide such training? (yes/no)

c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? **YES**

d. Is the sponsor's projected in-house staffing level sufficient considering its other work load, if any, and the project schedule? **YES**

e. Can the sponsor obtain contractor support, if required in a timely fashion? **YES**

f. Will the sponsor likely request USACE assistance in acquiring real estate? **YES - only in advisory capacity**

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site? **YES**

b. Has the sponsor approved the project/real estate schedule/milestones? **NO – Project Milestone will be developed during PED if required and will be joint effort between RE, PM and NFS**

Exhibit A
1st page

IV. Overall Assessment:

a. Has the sponsor performed satisfactory on other USACE projects? **YES**

b. With regard to the project, the sponsor is anticipated to be: **Highly capable**

V. Coordination:

a. Has this assessment been coordinated with the sponsor? **YES**

b. Does the sponsor concur with this assessment? **YES**

Prepared by:

Belinda Estabrook

Realty Specialist

Reviewed and approved by:

Ralph J Werthmann

Ralph J. Werthmann
Chief, Real Estate Division

Exhibit A
2nd page

AUTHORIZATION FOR ENTRY FOR CONSTRUCTION

I ______________________________, ________________________ for the
(Name of accountable official) (Title)

(Sponsor Name)______, do hereby certify that the ____(Sponsor Name) has acquired the real property interest required by the Department of the Army, and otherwise is vested with sufficient title and interest in lands to support construction for (Project Name, Specifically identified project features, etc.). Further, I hereby authorize the Department of the Army, its agents, employees and contractors, to enter upon ______________________
(identify tracts)

to construct (Project Name, Specifically identified project features, etc.) as set forth in the plans and specifications held in the U. S. Army Corps of Engineers' (district, city, state)

WITNESS my signature as ____________________________ for the
(Title)

(Sponsor Name) this __ day of _____________, 20_________.

BY: ______________________
(Name)

____
(Title)

ATTORNEY'S CERTIFICATE OF AUTHORITY

I, ________________________ , ______________________________ for the
(Name) (Title of legal officer)

(Sponsor Name), certify that __________________________ has
(Name of accountable official)

authority to grant Authorization for Entry; that said Authorization for Entry is executed by the proper duly authorized officer; and that the Authorization for Entry is in sufficient form to grant the authorization therein stated.

WITNESS my signature as ______________________ for the
(Title)

(Sponsor Name), this________day of_____________, 20____.

BY: ______________________
(Name)

____
(Title)

Exhibit B